1992-1993 Fruit Production Recommendations

Ontario

Ministry of Agriculture and Food

APPLES
APRICOTS
BLUEBERRIES
CHERRIES
CURRANTS GOOSEBERRIES
GRAPES
PEACHES NECTARINES
PEARS
PLUMS
RASPBERRIES BLACKBERRIES
STRAWBERRIES

To the best of the collective knowledge of the members of the Ontario Crop Protection Committee, all pesticides listed in this publication were federally registered, reviewed by the Ontario Pesticides Advisory Committee and classified by the Ministry of the Environment as of November 5, 1991.

Regulation 751 under the Pesticides Act requires that pesticides be used in accordance with the product label and in accordance with the Regulation. The information contained in this publication is general information only and is subject to the specific information and recommended uses listed on the pesticide container label and the provisions of Regulation 751.

PAY CLOSE ATTENTION TO ALL INSTRUCTIONS AND WARNINGS PRINTED ON THE PESTICIDE LABEL.

The Ministry of Agriculture and Food, or the Ontario Crop Protection Committee by printing this publication does not offer any warranty or guarantee and they do not assume any liability for any crop loss, animal loss, health, safety or environmental hazard caused by the use of a pesticide mentioned in this publication.

POLICY STATEMENT

In Publication 360, most recommendations list several pesticides that are effective for each insect or disease discussed. Where possible, the less hazardous materials and those that growers have used satisfactorily for a number of years are listed first. These are followed by the more toxic pesticides and/or newer ones with which we have less experience. It must be emphasized that, in some cases, the most effective pesticides are highly toxic.

Weather and other factors influence the effectiveness of pesticides and the likelihood of plant injury by control chemicals. Consult the package label and other information regarding compatibility with other materials, the effect of high or low temperatures, poor drying conditions, etc. Wettable or soluble powders (WP or SP) generally are less likely to cause plant injury than liquid concentrates (EC, SC, and F).

A number of brand names of pesticides are given in the calendars as a convenience to the grower and are neither an endorsement of the product nor a suggestion that similar products are not effective.

The pesticide recommendations are reviewed annually by the Ontario Crop Protection Committee. **OLD EDITIONS SHOULD BE DISCARDED.** For additional information or clarification of recommendations, contact Ontario Ministry of Agriculture and Food personnel listed on page 2.

Health and Welfare Canada has established maximum residue limits (MRL's) for pesticides. However, growers should be aware that processors or retailers may demand different pesticide limits. Growers should seek advice of their intended market as to which restrictions or limitations are applicable.

FEDERAL REGISTRATION AND PROVINCIAL CLASSIFICATION

Ontario's Pesticides Act and Regulation 751, administered by the Ministry of the Environment, prohibits the sale and use of pesticide products unless they are registered under the federal Pest Control Products Act and classified under the provincial Pesticides Act by being placed in one of six schedules of the Ontario regulation.

FEDERAL REGISTRATION

There are three categories:

1. **Full Registration**
   Implies that all federal departments involved in the registration process agreed that the data package was acceptable at the time of registration.
2. **Temporary Registration**
   Indicates that there is a need for additional scientific or technical information to acquire a full registration. Temporary registrations expire on the 31st of December each year and the products must be re-registered if they are to be available for use in the following year.
3. **Temporary Registration (Restricted Class)**
   Indicates that there is an urgent need for the pesticide but that studies on the safety of the product are incomplete. Such registrations expire on the 31st of December each year and the products must be re-registered if they are to be available for use the following year.

PROVINCIAL CLASSIFICATION

Pesticide products are classified into six schedules in Regulation 751 on the basis of their toxicity, environmental or health hazard, persistence of the active ingredient or its metabolites, concentration and usage. This classification system provides the basis for regulating the distribution, availability and use of pesticide products in Ontario.

For updated information on the regulatory status of these or other pesticides contact the Pesticides Section, Hazardous Contaminants Coordination Branch, Ministry of the Environment, Toronto. Telephone (416) 323-5095.

FARMER CERTIFICATION — Agriculturalists applying pesticides in the production of agricultural products on their properties are required to be certified.

For details on the Pesticide Safety Course contact your county office of the Ontario Ministry of Agriculture and Food.

Cette publication est aussi disponible en français.

92-05056/

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This issue of Publication 360 contains crop production information for both 1992 and 1993. Be sure to keep it for these two years. For 1993, a supplement containing updated information and recommendations will be issued.

HORTICULTURAL ADVISORS – FRUIT CROPS

Area Served or Specialty	Name	Address	Phone No.
Eastern Ontario	Kevin Schooley	College of Agricultural Technology Kemptville, K0G 1J0	613-258-8359
Prince Edward, Hastings, Lennox/ Addington, Frontenac	Allan Moynes	P.O. Box 470, Picton, K0K 2T0	613-476-3224
Northumberland, Peterborough	Dave Ridgway	P.O. Box 340, Trenton, K8V 5R5	613-392-3527
Durham, Victoria	Tom Clarke	234 King Street East Bowmanville, L1C 1P5	416-623-3348
Simcoe, Dufferin, Grey	Ken Wilson	P.O. Box 69, Clarksburg, N0H 1J0	519-599-2042
York	Rhonda Nauta	Muck Research Station R.R. #1, Kettleby, L0G 1J0	416-775-3783
Peel, York	Chris Kessel	Unit 9, 35 Van Kirk Drive Brampton, L7A 1A5	416-451-5474
Halton, Wellington, Wentworth	Joe Uyenaka	R.R. #1, Ancaster, L3Y 3K9	416-527-2995
Niagara Peninsula	Burke McNeill	Vineland Station, L0R 2E0	416-562-4147
Haldimand-Norfolk, Brant	Pam Fisher	P.O. Box 587, Simcoe, N3Y 4N5	519-426-7120
Oxford, Elgin, Perth, Waterloo	Keith Priest	P.O. Box 666, Woodstock, N4S 7Z5	519-537-6621
Lambton, Middlesex, Huron	John Gardner	50 King St., London, N6A 2P2	519-434-6811
Essex, Kent	Leslie Huffman	Research Station, Harrow, N0R 1G0	519-738-2251
Marketing	Bob Cobbledick	Vineland Station, L0R 2E0	416-562-4142

PEST MANAGEMENT ADVISORS – FRUIT CROPS

Prince Edward, Hastings, Northumberland		P.O. Box 340, Trenton, K8V 5R5	613-392-3527
Durham, York	Andrea Clark	234 King St. East, Bowmanville, L1C 1P5	416-623-3348
Georgian Bay	Alison Smith	P.O. Box 69, Clarksburg, N0H 1J0	519-599-2042
Niagara Peninsula	Kevin Ker Gerald Walker	Vineland Station, L0R 2E0	416-562-4147
Brant, Haldimand, Norfolk, Oxford	Bernt Solymar	P.O. Box 587, Simcoe, N3Y 4N5	519-426-7120
Elgin, Middlesex, Lambton, Huron	Paul Hagerman	50 King St., London, N6A 2P2	519-434-6811
Essex, Kent	Todd Leuty	Research Station, Harrow, N0R 1G0	519-738-2251
Provincial Plant Pathologist	Craig Hunter	P.O. Box 587, Simcoe, N3Y 4N5	519-426-7120

Agriphone Numbers – for regularly up-dated recorded messages re. pest control in fruits/vegetables

Kingsville	519-733-3151	Hamilton	416-527-9117	Bowmanville	416-623-4944
London	519-438-1014	Vineland	416-562-4345	Smithfield	613-392-3422
Woodstock	519-537-7161	St. Catharines	416-687-6611	Kemptville	613-258-5836
Simcoe	519-426-9664	Georgian Bay	519-599-2915		

ONTARIO MINISTRY OF THE ENVIRONMENT – PESTICIDES CONTROL FIELD OFFICES

Regions/Counties	Field Offices	Telephone
Southwestern Region		
Bruce, Grey, Huron, Perth	B.T. Lobb Ont. Ministry of Agr. & Food Bldg. 20 King St., Box 688, Clinton, Ontario N0M 1L0	519-482-3428
Essex, Kent, Lambton	H.E. Collins P.O. Box 726, 435 Grand Ave. W., Chatham, Ontario N7M 5L1	519-354-2150
Elgin, Middlesex, Oxford	D.C. Morrow/W. Lampman 985 Adelaide St. S., London, Ontario N6E 1V3	519-661-2200
West Central Region		
Haldimand, Norfolk, Niagara, Hamilton, Wentworth, Dufferin, Wellington, Waterloo, Brant	P. McCubbin/L. Dennie Ontario Government Building 119 King St. W., Hamilton, Ontario L8N 3Z9	416-521-7640
Central Region		
Halton, Peel, York, Durham, Toronto, Simcoe, Muskoka	A.G. Carpentier/H. Ploeg/C. Zubovits 7 Overlea Blvd., 4th floor, Toronto, Ontario M4H 1A8	416-424-3000 416-467-3029
Peterborough, Victoria, Haliburton, Northumberland	A.G. Carpentier 139 George St. N., Peterborough, Ontario K9J 3G6	705-743-2972
Southeastern Region		
Frontenac, Hastings, Lennox & Addington, Prince Edward, Leeds & Grenville	D.A. Raddon/M. Ferguson 133 Dalton Ave., Box 820, Kingston, Ontario K7L 4X6	613-549-4000
Prescott & Russell, Renfrew, Stormont, Dundas & Glengarry, Ottawa-Carleton, Lanark	R.P. Cameron 2378 Holly Lane, Suite 204, Ottawa, Ontario K1V 7P1	613-521-3450
Northeastern Region		
Manitoulin, Nipissing, Parry Sound, Sudbury, Cochrane, Timiskaming, Algoma	T. Spires/J. Negusanti/K. McDonald 199 Larch Street, Sudbury, Ontario P3E 5P9	705-675-4501
Northwestern Region		
Kenora, Rainy River, Thunder Bay	G.R. Gammond Ontario Government Building 435 James St. S., Thunder Bay, "F", Ontario P7C 5G6	807-475-1215
Head Office		
Hazardous Contaminants Branch	Pesticides Section 135 St. Clair Avenue W., Suite 100, Toronto, Ontario M4V 1P5	416-323-5095
Approvals Branch	Pesticide Licencing & Examination Section, 3rd Floor, 250 Davisville Ave., Toronto, Ont. M4S 1H2	416-440-3713

PUBLICATIONS

- *Personal Protective Equipment for Pesticide Users*
- *Chemicals Safety Handbook*
- *Pesticides Act and Regulations*

WARNING SIGN
(attach to entrance door
of farm chemical storage)

Available from any of the Pesticide Control Field offices or from the Pesticides Section, Hazardous Contaminants Branch, 135 St. Clair Avenue W., Suite 100, Toronto, Ontario M4V 1P5.

READ THIS ENTIRE SECTION BEFORE USING ANY PESTICIDES

PRECAUTIONS WITH ALL PESTICIDES

General Precautions

1. Always read the label before opening pesticide containers, and follow all precautions and directions. Before starting, keep a record of the common names of all pesticides handled, especially those listed as hazardous in this publication. This list should be known by members of your family for use in the event of an accident.
2. Use an anti-backflow device, to prevent back siphoning, when drawing water from wells, ponds, streams and other sources of water. Mix pesticide into the tank with sprayer at least 50 m from the water source. Triple or pressure rinse the empty container and add rinse water to tank. Only mix enough solution to do the spray job. After loading and mixing, wash down gloves and boots with clean water before removing.
3. Never smoke, chew tobacco or eat while handling or applying pesticides. Do not carry tobacco or food items in clothes worn while spraying. Change clothing and wash before eating.
4. When handling and mixing pesticide concentrates, rinsing empty containers or repairing leaks, a full set of protective clothing should be worn including waterproof cap, coveralls, impervious gloves and boots and eye protectors. If highly or extremely toxic pesticides are being used, a respirator should be worn. If very dusty formulations are being handled, a dust mask should be used. If volatiles or gases are being handled, a respirator must be worn. If these gases are highly dangerous or in an enclosed space, a self-contained breathing apparatus may be needed.
5. During application, a tractor cab with charcoal filter gives adequate protection against exposure. Impervious gloves, boots, coveralls and cap should be worn when tending to stoppages. When using airblast and mist blowers and tractors without cabs, waterproof suits including caps and impervious gloves and boots should be worn. When applying fumigants in the field, a respirator should be available for use in the event of problems with equipment, or escape of fumigant due to inadequate sealing in the soil.
6. When the spray operation is complete, bath or shower after spraying to remove pesticide deposits on the skin. Avoid handling anything in the home before bathing.
7. Well, pond and surface water may be contaminated by pesticides. Every effort should be made to avoid this happening. For more details, see **OMAF Factsheet, Guide to Handling and Applying Herbicide to Protect Water Supplies and Reduce Personal Exposure, Agdex 607.** It is an offence to contaminate surface waters with pesticides. To prevent this from occurring:
   - — Keep pesticide concentrates above flood plain in a locked storage.
   - — After emptying, triple or pressure rinse, crush and dispose of containers.
   - — Mix concentrate and water at least 50 m away from any water supply.
   - — Use appropriate buffer zones and berms to avoid surface water contamination of wells, ponds and streams.
   - — If possible, do not use drinking water sources to fill spray equipment.
   - — Do not spray within 10 m of shallow wells or 5-10 m of other water supplies under ideal conditions and farther away if there is any air movement. Stop spraying when wind velocity reaches 10 km/hr.
   - — There are government programs to protect your water supply and assist in building pesticide storage facilities.

IF ACCIDENTS OCCUR

1. If an accident occurs, remove contaminated clothing including underclothes immediately, and wash contaminated skin thoroughly with soap and water. Wash gloves, boots, respirator before and after removal. Presoak clothes and double launder immediately. If the spill was serious, place the clothes in a plastic bag and dispose of in a safe manner.
2. If clothing becomes wet with a pesticide during spraying, remove it immediately, wash and put on freshly laundered clothes.
3. If symptoms of illness occur during or shortly after handling or applying a pesticide, get the patient to a hospital immediately. Take the list of common-name chemicals with you to the hospital (see Emergency Procedures for Pesticide Poisoning on the back cover).
4. Clean up any pesticide spills immediately. In the case of minor spills, use dry soil or other absorbent material to remove excess liquid and sweep up powders and granulars. Contaminated soil and sweepings should be spread over a larger area of bare soil to facilitate rapid degradation. Make sure you are adequately protected when cleaning up the spill.

   In the case of a major pesticide "spill", the Ministry of the Environment, Spills Action Centre, 5th Floor, 7 Overlea Blvd., Toronto, Ontario, M4H 1A8, Telephone (416) 965-9619 or 1-800-268-6060 must be notified.
5. If a well becomes contaminated, follow clean-up instructions in OMAF Factsheet, *Pesticide Contamination of Farm Water Supplies,* Agdex 607.

EMERGENCY PROCEDURES FOR PESTICIDE POISONING AND FIRST-AID INFORMATION

(See Back Cover)

RELATIVE TOXICITY TO APPLICATOR

DEFINITIONS

Lethal Dose 50% (LD_{50}) The dose which when administered will kill 50% of the test animals within a stated period of time (i.e. 1 to 6 days).

Acute Toxicity Immediate adverse effects from a single or short period of exposure to a substance, either by the oral, dermal or inhalation route.

Chronic Toxicity Adverse effects resulting from repeated exposure to a substance over an extended period.

High Acute Toxicity

These pesticides are extremely dangerous if handled carelessly. The acute oral LD_{50} is less than 50 mg/kg of body weight and the acute dermal LD_{50} less than 200 mg/kg body weight. These pesticides can be fatal on taking less than 0.1 to 3 mL (one drop to half a teaspoonful). These pesticides carry the skull and crossbones in a stop sign. In using these products a respirator and eye protection is required along with all other protective clothing.

aluminum phosphide (Phostoxin)
azinphos methyl (Guthion, APM)
chlorophacinone (Rozol)
carbofuran (Furadan)
diphacinone (Ramik Brown, Ramik Green)
endosulfan (Thiodan) (Thionex)
methomyl (Lannate)
mevinphos (Phosdrin)
oxamyl (Vydate)
paraquat (Gramoxone)
parathion
zinc phosphide

Moderate Acute Toxicity

These pesticides are dangerous if handled carelessly. The acute oral LD_{50} is 50 to 500 mg/kg of body weight and the acute dermal LD_{50} is 200 to 2000 mg/kg body weight. These pesticides can be fatal on taking 3 to 30 mL (half a teaspoonful to 2 tablespoonfuls). These pesticides carry the skull and crossbones on a stop sign. In using these products a respirator is recommended when handling the concentrate.

1,3-D Telone IIB, Telone C-17-R, Vorlex Plus, Vorlex Plus CP
cypermethrin (Cymbush) (Ripcord)
deltamethrin (Decis)
diazinon (Basudin)
dimethoate (Cygon)
fenvalerate (Belmark)
formetanate hydrochloride (Carzol)
oxydemeton-methyl (Metasystox)
methidathion (Supracide)
phosalone (Zolone)
phosmet (Imidan)
pirimicarb (Pirimor)

Low Acute Toxicity

These pesticides are not fatal unless deliberately ingested in amounts of over 30 mL (1 oz.). The acute oral LD_{50} is greater than 500 mg/kg body weight and the acute dermal LD_{50} greater than 2000 mg/kg body weight. Pesticides listed in this publication and not appearing in the lists in this section have low acute toxicities and should be handled with caution. Protective clothing is required. Respirators are advised when used in confined spaces. Eye protection is advisable.

Chronic Toxicity

It is not possible to assess chronic toxicity of a pesticide in the same way as an LD_{50} is used to determine acute toxicity. Instead, a number of tests are performed on animals which help predict whether a pesticide will cause a number of possible long-term effects. Animals are examined for a wide variety of toxic effects such as the production of tumors or abnormalities. Protective clothing and equipment is advisable to reduce exposure and the risk of chronic effects.

1,3-D (Telone IIB, Telone C-17-R, Vorlex Plus, Vorlex Plus CP).

BLOOD TESTS FOR THOSE APPLYING PESTICIDES

Organophosphorus and carbamate pesticides are capable of inactivating the serum and the red blood cholinesterase levels. If the activity of cholinesterase falls below a critical level, human poisoning can result as exhibited by fatigue, dizziness, nausea, trembling, blurred vision, difficulty in breathing and other symptoms.

For those working outdoors and applying these groups of pesticides, it is strongly recommended that cholinesterase levels be checked by your family doctor. To be of value, the tests should be commenced **before** using these pesticides and not after applications have commenced, since the normal level per individual can vary considerably, making it difficult to assess the degree of suppression. In this publication the primary insecticides of concern are:

azinphos-methyl (Guthion, APM)
carbaryl (Sevin)
carbofuran (Furadan)
diazinon (Basudin)
dimethoate (Cygon)
methidathion (Supracide)
methomyl (Lannate)
oxamyl (Vydate)
parathion
phosalone (Zolone)
phosmet (Imidan)
pirimicarb (Pirimor)

PROTECTIVE CLOTHING WHEN USING PESTICIDES OUTDOORS

1. **Why Use Personal Protection?** Pesticide formulations vary in their toxicity from slightly to extremely poisonous. Once the pesticide is removed from the container, exposure occurs. The toxicity of the pesticide and the exposure to the user creates a hazard which varies from spray operation to spray operation. Both can be reduced, toxicity by dilution and exposure by protective clothing. The action taken by the applicator to reduce the hazard of a spray operation reduces the risk of poisoning. While the hazard of a situation remains, the risk can be reduced by the care and protection followed by the applicator. Wearing the required protective clothing reduces the risk.

2. **Risk of each stage in pesticide operation.**
   1) Handling and mixing concentrate – very high risk
   2) Rinsing empty containers – high risk
   3) Application outdoors – low to high risk
   4) Application indoors – medium to very high risk
   5) Clean-up, equipment rinsing – medium to high risk
   6) Reentry into treated area within 48 hours – low to medium risk

TABLE 1. SAFETY SUPPLY COMPANIES IN ONTARIO PROVIDING PROTECTIVE CLOTHING AND/OR RESPIRATORY DEVICES FOR OUTDOOR PROTECTION AGAINST CERTAIN PESTICIDES

Respiratory Devices Manufactured By	Available From	Telephone
American Optical	AOCO Limited, Subsidiary of American Optical Corporation, 80 Centurian Drive, Markham L3Y 5Y5 Branches: Hamilton & Belleville	(416) 479-4545
H.S. Cover (York)	Levitt-Safety Ltd., 33 Laird Drive, Toronto, M4G 3S9 Branches: Kitchener, London, Ottawa, Sarnia, Stoney Creek, Sudbury and Thunder Bay	(416) 425-8700
Kasco Helmets	The St. George Co., R.R. #1, St. George, N0E 1N0	(519) 442-2046
Mine Safety Appliances	MSA Canada Inc., 148 Norfinch Drive, North York, M3N 1X8	(416) 667-9400
3M Canada Inc. Occupational and Environmental Safety Division	A wide range of Distributors. Contact: P.O. Box 5757, London, N6A 4T1	(519) 451-2500
North	Siebe-North Inc., 26 Dansk Court, Rexdale, M9W 5V8	(416) 675-2810
Racal Airstream	Safety Supply Canada, 90 West Beaver Creek Road, Richmond Hill (Toronto), L4B 1E7 Branches: Hamilton, Kingston, Kitchener, London, St. Catharines, Sarnia, South Porcupine, Thunder Bay and Windsor	(416) 222-4111 (416) 222-2111
Safety House	Safety House of Canada Ltd., 1275 Castlefield Ave., Toronto, M6B 1G4 Branches: Kitchener, London, Orillia, Ottawa, St. Catharines and Stoney Creek	(416) 789-0631
Scott	Safety Supply Canada, 90 West Beaver Creek Road, Richmond Hill (Toronto), L4B 1E7 Branches: Hamilton, Kingston, Kitchener, London, St. Catharines, Sarnia, South Porcupine, Thunder Bay and Windsor	(416) 222-4111 (416) 222-2111
Survivair	Levitt-Safety Ltd., 33 Laird Drive, Toronto, M4G 3S9 Branches: Kitchener, London, Ottawa, St. Catharines, Sarnia, Stoney Creek, Sudbury and Thunder Bay	(416) 425-8700
Willson	Safety Supply Canada, 90 West Beaver Creek Road, Richmond Hill (Toronto), L4B 1E7 Branches: Hamilton, Kingston, Kitchener, London, St. Catharines, Sarnia, South Porcupine, Thunder Bay and Windsor	(416) 222-4111 (416) 222-2111

Many of the companies listed above have dealer outlets in addition to branch outlets. For details of dealer outlets contact the supply company of your choice.

3. **Exposure can be by way of skin, eyes, mouth, or nose.** Approximately 80-85% of the exposure in most spray operations is during mixing and loading of the concentrate. Field application usually accounts for 15-20% of the exposure. Skin exposure is usually 90 to 100% of the total exposure and around 70% of this is by way of the hands and forearms and 30% involves the rest of the body. Inhalation (nose and mouth) exposure is normally 0.1% but increases to 5-10% with mist blowers and air blast sprayers.

4. **To reduce skin (dermal) exposure,** wear impervious gloves (neoprene, rubber, etc.) and waterproof boots, along with coveralls, apron or spray suits and waterproof cap. Coveralls can be reusable or disposable. Reusable coveralls are normally cotton or polyester and should be tightly woven. Polyester is more easily penetrated than cotton. Disposable coveralls are polyethylene and can be laundered several times. Spray suits should be used in highly hazardous conditions as with mist blowers and air blast machines. Eye protection should be practised with all pesticide concentrates.

5. **Respirators are recommended** when handling pesticides with labels that call for respiratory protection and carry the warning stop sign with skull and crossbones. Respirators should be used when spraying all pesticides rated as high toxicity or when applying any liquified gas. Respirators are available as air purifiers or self-contained units. Respirators come in a wide range of shapes and sizes; consult the label and your nearest safety supply company for advice.

6. **Washing and laundering protective clothing**
To keep your protective clothing and equipment functional, clean it thoroughly. Never allow children or pets to come into contact with contaminated clothing or equipment. To this end, launder clothing promptly, wash and store other items used for personal protection and rinse down spray equipment and store to prevent children playing on it. Here are some general guidelines for cleaning items used for personal protection.

   (1) **Fabric clothing** — If fabric clothing is saturated with the concentrate of a highly toxic pesticide, then discard the clothing. Remove the clothing carefully and immediately place in a plastic trash bag and dispose in a safe manner. Wear rubber, vinyl, or plastic gloves when handling severely contaminated clothing. Presoak and double launder clothes that may have been contaminated by a normal spray operation, preferably twice a day but at least at the end of the work day, following these guidelines:
   - — prerinse clothing outdoors
   - — presoak in a suitable container such as a large bucket or tub; or use the prewash cycle of an automatic washer, with detergent
   - — wash contaminated clothing separately from all other clothing
   - — prewash, solvent-based products have been found effective on EC formulations
   - — wash clothes using hot water, the highest water level, and a regular hot super wash cycle
   - — use heavy-duty liquid detergents for all pesticides and use adequate amounts (see laundry detergent box)
   - — wash only a few contaminated garments at a time
   - — use two complete wash cycles, each with a double rinse
   - — after washing run another wash cycle with detergent and no clothing to decontaminate the washing machine
   - — line dry to avoid a potential build-up of pesticide residue in the dryer

   (2) **Rubber, Vinyl, or Plastic Boots and Gloves** — To avoid getting pesticide on your hands, wash the outside of boots and gloves with detergent and water before removing. After removing boots and gloves, wash them inside and out with detergent and water, rinse thoroughly, and dry in a well-ventilated area.

   (3) **Chemical-Resistant Clothing, Goggles and Face Mask** — Wash plastic or rubber clothing and equipment with detergent and water, rinse thoroughly, and dry in a well-ventilated area.

   (4) **Respirators** — Discard cartridges, canisters and filter pads either: (1) when breathing becomes difficult, (2) when a pesticide odor is noticed, or (3) at the time interval specified by the manufacturer. Write the date the cartridge is first used. Wash the face piece in detergent and water, rinse it thoroughly, and dry it in a well-ventilated area. Never use alcohol or other solvents for cleaning – they will damage rubber and plastic.

7. **Consult the safety supply house** of your choice for appropriate guidance and selection of your protective clothing. See Table 1.

REENTRY TO TREATED AREAS

Pesticide poisoning may occur when workers enter fields too soon after pesticides have been applied. Such poisoning can result from handling treated plants or from inhalation of pesticide vapors.

The pesticides listed below are those for which a specific minimum interval must be observed from the time of application to the time of working in the crop. For some pesticides, e.g. parathion, the label carries a warning regarding working in treated crops. **Follow these recommendations.** Where no label warnings are provided, the following minimum intervals are recommended.

24 Hours	48 Hours	7 Days
Lannate (methomyl)	APM (azinphos-methyl)	Parathion
Supracide (methidathion)	Guthion (azinphos-methyl)	
Vydate (oxamyl)	Furadan (carbofuran)	

STORAGE

1. **General Storage:**

   The Ontario Pesticides Act and Regulation 751 requires that all pesticides be kept out of the reach of children, irresponsible persons, pets and livestock. They should be stored in a locked facility away from food for humans and feed for animals. Herbicides should be stored separately from other pesticides to avoid possible contamination.

Special Storage:

1. Schedule 1, 2 and 5 pesticides must be stored in a storage facility which is ventilated to the outside atmosphere. A placard bearing the words **"Chemical Storage Warning – Authorized Persons Only"** in block capitals must be affixed to the outside of each entrance. Entry to the storage facility should only be made by the person responsible for the pesticide, or with his permission.
2. **Always store pesticides in original containers and keep them tightly closed. Never put pesticides in unmarked containers.**
3. In areas where flooding has been a frequent occurrence, fertilizers and pesticides must be stored above the known highwater mark to avoid contamination of the flood waters. Contamination of water by these chemicals can and has led to serious health problems affecting humans and domestic animals as well as fish and wildlife.
4. Respiratory equipment and protective clothing must be available close at hand, outside the actual storage area.
5. Emergency telephone numbers must be displayed in a prominent place, outside the storage room.

TRANSPORTATION OF PESTICIDES

Recent implementation of additional regulations under the Pesticides Act emphasize the importance of safe handling of pesticides during transportation to, and on, the farm.

1. Do not carry or transport pesticides in the cab or passenger area of any vehicle.
2. Never leave pesticides unattended in parked vehicles unless the vehicle is locked or parked in an area to which the public is denied access.
3. Unattended parked vehicles containing pesticides must be prominently signed.

DISPOSAL OF PESTICIDE CONTAINERS & CONTAMINATED MATERIAL

1. All paper or cardboard pesticide containers or paper packaging material, or other paper material used to clean up spills should be buried or burned. Make sure that people and animals are kept away from the smoke, and that the smoke is not directed toward buildings, highways, roads, or outdoor public areas. Plastic material must not be burned.
2. Unrinsed containers can contain as much as 3% of the original formulation. If this amount of toxic pesticide is discarded with the container it could be dangerous to other people handling it, or to the environment (for example, your water supply). Failure to rinse is also wasteful – why not use that 3% for the purpose for which it was purchased, i.e., to control the pest!
3. Rinse all empty metal, plastic or glass containers three times with water and add washings to the spray tank. Or, use a rinsing device. These rinsers can be used to puncture the bottom of a metal or plastic container and rinse the residue left in the container directly into the spray tank. This procedure takes less than a minute. The rinsed containers may be crushed, buried and covered by at least 50 cm of soil, away from any watercourse or water table, or disposed of at a landfill site.
4. Unwanted or contaminated pesticide product should be disposed of through TRICIL Environmental Management **(1-800-263-2432)**, or by contacting the appropriate registrant to develop an alternative method acceptable to the Director under the Pesticides Act **(1-416-323-5095)**.

Farm Water Supplies

Well, pond and surface water may be contaminated by pesticides. Every effort should be made to avoid this from happening. For more details see OMAF Factsheet *Pesticide Contamination of Farm Water Supplies*, Agdex 607. As a guide this summary is included here.

It is an offense to contaminate surface waters with pesticides. To avoid these occurrences:

1. Keep pesticide concentrates above flood plain in a locked storage.
2. Triple or pressure rinse, crush and dispose of containers after emptying.
3. Mix concentrate and water at least 50 m away from the farm water supply.
4. Use appropriate buffer zones and berms to avoid surface water contamination of wells, ponds and streams by spray drift or surface runoff waters.
5. Draw drinking water supplies from a separate well – preferably drilled to at least 50 m.
6. Do not spray within 10 m of shallow wells or 5-10 m of other water supplies under ideal conditions and farther away if there is any air movement. Stop spraying when wind velocity reaches 10 km/hr.
7. Decontamination of well and pond waters is a long, involved and costly process, avoid contamination in the first place.

POLLINATION

Most fruit crops benefit from or require insect pollination. Honey bees are particularly valuable. Growers and beekeepers are referred to OMAF Publication 72, *Pollination, Crops, and Bees* and OMAF Factsheet, *Honeybees for Pollination of Crops*, Agdex 616 and OMAF Publication 71, *Honeybees and Pesticides*, for protection of their pollinators.

Many growers provide for this by arranging to have beekeepers move honeybee colonies into the crop during the blooming period. The following suggestions may help in utilizing the services of honeybees more efficiently for this purpose:

1. Obtain honeybees from a reliable beekeeper who is able to supply strong, healthy colonies. Weak colonies are of little value for early spring pollination when cool weather is often encountered.
2. Two to three colonies of honeybees per hectare should provide satisfactory pollination for most fruits. In young orchards fewer bees may be required. However, because of the unfavorable weather frequently encountered during the time when the earlier-blooming apricots, cherries and plums are in blossom, the grower may be well advised to use more bees per hectare. For use with pollen inserts, five colonies per hectare are suggested.
3. Set out the colonies after the blossoms have partially opened (earlier for sweet cherries). This will encourage

a greater number of bees to work on the fruit blossoms in the surrounding orchard rather than to forage elsewhere. This consideration is extremely important for the effective use of pollen inserts.

4. Because cool weather is often encountered during fruit bloom, encourage maximum honeybee flight by giving the colonies some protection from cold spring winds. Place the colonies in small, or large, groups in sunny, sheltered locations. Where no natural windbreak is available, it is wise to erect a temporary wind shelter. Bales of straw are quite satisfactory for this purpose. Try to place the colonies so that the morning sunshine will strike the hive entrances.

NOTE: Pollination cannot be expected to produce results in orchards that are suffering from nutritional deficiencies, insect or disease problems, poor drainage, or other adverse conditions. Do not expect greatly improved crops from the use of bees and pollen inserts until such deficiencies have been corrected.

A pollen insert is a device that can be inserted into the entrance to a honeybee colony in such a way that bees leaving the hive are forced to crawl through a shallow tray containing pollen from the desired pollenizer. Sufficient pollen will usually adhere to the legs and body of each foraging bee to enable it to cross-pollinate the blossoms it visits. For additional information on the use of pollen inserts, consult the Horticultural Crop Advisor serving your area, or the Department of Environmental Biology, University of Guelph.

REDUCE BEE POISONING

Bees are essential for the pollination of most tree and small fruits. Insecticides, many of which kill bees, are required for insect control. With careful management, you can obtain both pollination and insect control. You can protect the bees by following these suggestions:

1. **Do not apply insecticides while tree fruits are in bloom. The "Bees Act" makes it an offence to do so in Ontario.**
2. Remove honeybee colonies as soon as pollination is complete and before any postbloom insecticides are applied.
3. Time of treatment is important. In general, daytime treatments, when bees are foraging in the field, are most hazardous. Insecticide applications in the very early morning or evening are safest.
4. If there is a risk of honeybee poisoning, try to choose an insecticide that is not highly toxic to the bees (use pesticide rating, see below).
5. Honeybees frequently are poisoned by visiting cover crops, such as dandelions or clovers, that are in bloom in the orchard. Clipping or beating down such crops prior to spraying will help safeguard the bees.

Extremely Toxic to Bees – Furadan, Sevin

These insecticides have caused more loss (confirmed cases of poisoning) to bees than any of the other materials listed below. Fruit growers and apiarists require close liaison where these materials are applied.

The following groups (chemicals used with fruit crops) show the relative toxicity of pesticides to honeybees as determined by laboratory and field tests in California.

Group I – Pesticides Highly Toxic to Bees

Severe losses may be expected if the following materials are used when bees are present at treatment time or within a few days thereafter:

Ambush	Elgetol	Phosdrin
APM	Furadan	Pounce
Belmark	Guthion	Ripcord
Cygon	Imidan	Sevin
Cymbush	malathion	Supracide
Decis	parathion	Vydate
diazinon		

Group II – Pesticides Moderately Toxic to Bees

These can be used around bees if dosage, timing, and method of application are correct, but should not be applied directly on bees, in the field or at the colonies:

Carzol	Metasystox	Thiodan
Dikar	Pirimor	(Thionex)
Lannate	Systox	Zolone

Group III – Pesticides Relatively Non-Toxic to Bees

Apollo	Equal	Omite
Benlate	ferbam	Phaltan
Bordeaux	Folpan	phygon
captan	Funginex	Polyram
Cyprex	Karathane	Ridomil
Dithane	Kelthane	Rovral
Dyrene	Kumulus	sulphur
Easout	Manzate	zineb
ethion	Morestan	

For more detailed information on the toxicity of specific pesticides to honeybees refer to OMAF Publication 71, *Honeybees and Pesticides.*

INTEGRATED PEST MANAGEMENT

Much has been said in recent years about integrated pest management and reduced use of pesticides. In Ontario, integrated pest management has been a part of the pest control program. While it is not possible at this time to include a complete integrated pest management program in the recommendations, significant progress has been made and growers are urged to take advantage of the additional information.

THE CONCEPT

In the late 1960s, it became apparent that total reliance on chemical pesticides for pest control was not a good practice. A decision was made to move as quickly as possible to more efficient use of pesticides in Ontario agriculture. The concept of integrated pest control was adopted. This involves all possible methods of pest control, including various horticultural practices, to maintain pests at low levels so that they do not cause economic damage.

In Ontario, the first major program of integrated pest management was developed with the peach crop. Success in that area has permitted expansion into other crops.

Presently, much of the progress in pest management has been due to effective methods of monitoring for pests so that treatments are now available on apples, grapes, pears and peaches in the areas of the province with concentrations of these crops.

The programs have provided good control at reduced cost because of a reduced number of spray treatments.

WHAT IS INVOLVED

The keys to successful integrated pest management are: selecting tolerant varieties for new plantings; practicing good sanitation by removing wild hosts that may carry pests; and using sound cultural practices and applying treatments with a properly functioning sprayer. The use of sex pheromones and other attractants by which specific insects can be drawn into traps has been a major development in improving our ability to determine when pests are present and at what levels sprays must be applied.

In addition, pest management includes proper selection of pesticides and dosage rate so that minimum damage is done to beneficial parasites and predators. Spray applications are then timed to critical stages in the development of the pest. There is, thus, an intensive involvement of the Horticultural Crop Advisor, Pest Management Advisor, and the grower working as a team to arrive at the best control practice. This is not a program on which farmers can embark on their own. Rather, they should be in regular contact with the Horticultural Crop Advisor or Pest Management Advisor to develop and carry out their program.

How to Get Information

The Plant Industry Branch of the Ontario Ministry of Agriculture and Food has developed a network of Agriphones (page 2) that will provide for specific areas data on weather, horticultural advice, the status of insect and disease pests, and general information of value to the grower in planning the crop production program. Agriphones are not available in all areas and it is important that the grower check with the Horticultural Crop Advisor (page 2) to determine if the information needed for a pest management program is available in the area, and how to get involved in the program.

In order to make pest monitoring and advisory services more available to growers, local Pest Management Advisors have been provided to work with Horticultural Crop Advisors in Ontario.

PESTICIDE DRIFT

Pesticide drift can leave unwanted residues on adjacent crops, be a hazard to people and livestock nearby, or reduce the amount of material in the target area so that it is ineffective. Those applying pesticides should make every effort to minimize or prevent pesticide spray drift by paying attention to:

1. correct calibration and maintenance of spray equipment
2. correct operation of the equipment
3. the toxicity of the pesticide in use
4. the weather conditions

PESTICIDE INJURY TO CROPS

Although insecticides and fungicides have been selected and formulated to avoid plant injury, damage can still occur under some conditions. In addition to the precautions mentioned in this publication, there are a number of other precautions which should be observed:

1. Apply sprays when the drying condition is fast. Some chemicals break down to components which are injurious to plant tissues if they are permitted to stay wet.
2. Apply sprays when the temperature is below 27°C. The spray deposits serve as a lens and concentrate the heat on the plant tissues.
3. Be particularly careful when plants have been under growth stress such as prolonged periods of drought, excessive cloud cover, extremely low or high temperatures.
4. Apply sprays soon after mixing. Undesired chemical change may take place with some chemicals if the sprays remain in the tank for prolonged lengths of time (e.g. overnight). In other cases, the chemicals may settle out and clog the lines.

PEST RESISTANCE TO INSECTICIDES, FUNGICIDES AND MITICIDES

Pests are said to be resistant when they are able to survive exposure to rates of pesticides that previously controlled them. Generally, resistance to a pesticide develops after repeated exposure to a specific chemical. Resistance occurs because a few naturally occurring resistant individuals survive after each spray, while the susceptible portion of the population is killed. These resistant survivors multiply and gradually replace the susceptible ones. Eventually only a resistant population remains, which cannot be controlled by the pesticide.

The development of resistance to pesticides can occur very quickly. The same chemical should not be used repeatedly without being alternated with a different chemical or without being used in combination with other chemicals having a different mode of action. This practice will reduce the likelihood of resistance developing in the pest population.

You should be aware that there are many chemicals which are the same or have the same mode of action, and which are marketed under different brand names; for example, the chemical dodine is marketed under the brand names CYPREX and EQUAL. Another important point is that different chemicals may have the same mode of action; for example, both Benlate and Easout act on the same site in the fungus and, therefore, have the same mechanism of control. Using Benlate after Easout is equivalent to using Benlate after Benlate, so resistance develops to both chemicals at the same time, even though only one may have been used repeatedly. This point is also true for the many synthetic pyrethroids.

Ask the Horticultural Crops Advisor or Pest Management Advisor in your area if you are unsure of which pesticides to alternate.

INSECTICIDES

SYNTHETIC PYRETHROIDS – Tentiform leafminer has become resistant to all synthetic pyrethroids (Ambush and Pounce, Belmark, Decis, Cymbush and Ripcord) in several orchards in Ontario. The repeated use of this pesticide family (more than once per season) is not encouraged because it reduces the number of beneficial insects and also results in the development of resistance in pest populations.

It has already been documented in western North America that pear psylla populations are resistant to pyrethroids. A preliminary study of pear orchards in the Niagara peninsula indicates that some pear psylla populations are resistant to synthetic pyrethroids. Resistance is now fairly widespread throughout Ontario.

It is feared that resistance will build up in the pear psylla population if the synthetic pyrethroids are used more than once per season.

LANNATE – Several cases of tentiform leafminer resistance to Lannate have been documented in Norfolk County.

FUNGICIDES

If you find that a well-timed fungicide application fails to control a disease at rates which previously controlled it, you should consider the possibility of resistance to the chemical by the pest organism.

BENLATE/EASOUT – Cases of resistant apple scab have been documented in most of the apple growing areas of the province. Resistance to Benlate has also been documented for brown rot on peaches and cherries, as well as for *Botrytis* on strawberries and grapes.

CYPREX/EQUAL – Apple scab has developed resistance to these identical chemicals in a moderate percentage of orchards in most of the apple-growing areas of the province. Resistance to Cyprex/Equal is persistent for many years once it is established in an orchard. These chemicals will then no longer control apple scab.

ROVRAL – *Botrytis*, the casual agent of bunch rot of grapes, has developed resistance in many vineyards after 4 years of use. Resistance is expected to develop to grey mould in strawberry fields as well. However, the resistant form of the fungus does not survive well, and declines when Rovral is not used for several years. If Rovral is only used once or twice per season, but not consecutively, resistance should remain at low levels and Rovral should remain effective.

Tests of the brown rot organism on cherries and peaches have indicated no resistant populations to date.

Rovral should not be used more than twice per season in order to delay the development of resistance.

MITICIDES

KELTHANE – European red mite resistance to Kelthane was widespread in the late 1960s and a survey in 1984 indicated that it was present in 4% of the apple orchards tested. Resistance to Kelthane is not stable and if the chemical is not used for 3-5 years, the population will gradually lose its resistance. However, if the chemical is used repeatedly, resistance is expected to return quite quickly.

USE OF FUNGINEX ON STONE FRUITS

Funginex is the first fungicide to be registered that belongs to the functional group of sterol inhibiting fungicides, also referred to as the SI, SBI or DMI group. Funginex has protective activity and is locally systemic, making it particularly effective for deactivating recent blossom infections. In Europe and the U.S.A., repeated use of SI fungicides over several years against powdery mildew has resulted in the emergence of SI-resistant powdery mildew against which SI fungicides have little activity. To minimize or delay the possible development of SI-resistant brown rot, we advise no more than two bloom applications of Funginex per year, preferably alternated with other registered fungicides if the need for additional protection is anticipated during the bloom period of cherry, nectarine, peach and plum.

DETERMINING SCAB INFECTION PERIODS

The fungus which causes apple scab has a fairly complex life cycle.

Determining Infection Periods: The fungus overwinters in the previous year's infected leaves on the orchard floor. In the spring, spores called "ascospores" are formed. These ascospores are released during periods of rain and infect the newly opening buds. Whether or not infection occurs is dependent upon both the length of the wetting period and the average temperature. This relationship is outlined in Table 2 (page 12). Infections of new apple tissues by ascospores produced from last year's leaves are termed **primary infections.** Olive green lesions appear on new leaves 10-28 days after a primary infection has occurred. The length of time it takes for lesions to appear depends on the average temperature after infection. These lesions produce another type of spore, termed "conidia", or summer spores. The amount of inoculum increases substantially once conidia appear. These conidia are spread by splashing rain and wind, and re-infect the leaves and developing fruit, if protection by fungicide is inadequate. This type of infection is termed a **secondary infection.** Conidia require slightly longer wetting periods than ascospores do to initiate infections (see Table 2, Page 12).

Infections of either type will happen only if moisture is present for a long enough period of time at a specific temperature. For a primary infection to occur, two things must happen: ascospores must be **released** by rain, and once released, they must have a long enough wet period at a given temperature to infect. The factors that govern **release** (rain causing leaf wetness between the hours of 8 a.m. and 7 p.m.) are slightly different than those required for **infection** (leaf wetness for a long enough period of time at a given temperature, at any time of day or night). For a secondary infection to occur, only leaf wetness for a long enough period of time at a given temperature is required.

The calculations required for determining primary infections are different than the calculations for secondary infections.

New research on some of the conditions needed for spore release, and infection, has required that some modifications be made to the Mill's system for determining infection periods.

(Continued on page 12)

Early in the season, all calculations will be for primary scab. If primary scab becomes established and lesions are present, both primary and secondary infections are possible. This will require two different calculations for the determination of (primary and secondary) scab infection periods. Trees must be protected by fungicide if either calculation indicates that an infection has occurred.

The primary scab season lasts until all the ascospores in last year's leaves are released. This varies from year to year, but typically lasts until late June. Secondary scab can occur throughout the season once scab lesions are present in the trees.

Determining Wetting Periods for Primary Infections

In order to get a primary scab infection, two events must occur:

1. ascospore **release** from last year's leaves, and
2. a long enough **leaf wetness period** at a certain **temperature** for the released ascospores to infect.

Without ascospore release, no infection is possible. In addition, ascospores cannot infect apple tissue if the proper leaf wetness and temperature conditions (as outlined in Table 2, "Relationship of Temperature and Moisture Scab Infection" page 12) are not met.

Ascospores are not *released* to any significant extent from *7 p.m. until 8 a.m.* (daylight savings time). Therefore, rain occurring between 7 p.m. and 8 a.m. will not initiate a primary scab infection period until 8 a.m., since ascospores must be released and be present on green tissue to initiate an infection. The calculations for the length of the infection period would start at 8 a.m., continuing until the leaves are dry. For example, if it started to rain at 1 a.m. and the leaves dried at 10 a.m., the length of the infection period was only 2 hours long (8 a.m. – 10 a.m.). If it started to rain at 1 a.m. and the leaves dried off at 11 p.m., the length of the infection period is 15 hours (8 a.m. – 11 p.m.). If it rained at 9 p.m. and the leaves were dry at 6 a.m., no infection period would be recorded.

A wet period starting between 8 a.m. and 7 p.m. could initiate an infection period as soon as wetting occurs, since ascospores can be released immediately. Therefore, calculations for the length of an infection period which starts between 8 a.m. and 7 p.m. begins as soon as the leaves are wet, and continues until the leaves are dry. For example, if it started to rain at 11 a.m. and the leaves dried off at 10 p.m., the length of the infection period is 11 hours (11 a.m. – 10 p.m.).

Determining Wetting Periods for Secondary Infections

Secondary scab occurs when conidia from primary lesions present on the tree are spread by splashing rain. As with primary infections, secondary infections only occur if moisture initiated by rainfall is present for a long enough period at a given temperature. Secondary infections can, however, occur day or night so all secondary infections are calculated from the beginning of the wetting period regardless of the time of day.

Once the length of the infection period has been determined, calculate the average temperature during this interval and check Table 2, page 12, to see if the leaves were wet long enough for an infection to occur.

Contribution of Intermittent Rain, Dew, etc., to Infection Periods

Periods of dew or high humidity (over 90%) will also contribute to a wetting period, but are significant only if preceded by rain. For example, if it begins to rain at 5 p.m. and stops at 10 p.m., and the leaves remain wet all night with dew, the total wetting period is calculated from 5 p.m. until the dew dries the following morning.

If dew occurs at 11 p.m. and it rains at 9 a.m. the following morning, the wetting period is calculated starting at 9 a.m. until the leaves are dry.

Wet periods during an intermittent rain should be added together to determine an infection period unless separated by 10 hours or more of dry, sunny weather. For example, if leaves are wet at 3 p.m. and dry by 7 p.m., rewet at 11 p.m. by dew and dry at 8 a.m., the total leaf wetness period is 13 hours (4 hours plus 9 hours).

The longer the wetting period over the minimum time required for an infection, the greater the severity of infection will be. For example, if the leaves are wet for 8 hours and the average temperature is 10°C, no infection has occurred (see Table 2). If, however, the leaves are wet for 15 hours at this temperature, a primary infection, but no secondary infection has occurred. At 20 hours, a primary infection as well as a secondary infection have occurred.

All times are Eastern Daylight Savings Time

Table 2. RELATIONSHIP OF TEMPERATURE AND MOISTURE TO APPLE SCAB INFECTION*

Average Temperature °C	Hours of wetting for infection	
	Primary Season	Secondary Season
1-3	48+	
4	36	
5	28	28
6	23	24
7	18	22
8	15	19
9	12	17
10	11	16
11	9	14
12	8.5	13
13	8	12
14	7.5	12
15	7	11
16	6.5	10
17	6	9
18	6	8
19	6	8
20	5.5	7
21	5.5	7
22	5.5	7
23	6	8
24	7	9
25	8	11
26	10	13
27	13	16
28	18	21

* *Adapted from MacHardy and Gadoury, 1989.*

Fruit Infection

Recent studies have confirmed that as fruit matures, it takes a progressively longer wetting period for infection by apple scab to occur. Table 3 gives this relationship. Wetting periods required for infection of fruit by scab are longer than those required for leaf infection. For orchards with only light primary leaf infection, the longer infection times required for fruit may be followed in those orchards where only fruit scab is of concern. **It should be pointed out that leaf infection, if unchecked during the growing season, could result in a great deal of overwintering scab and heavy ascospore releases next year.**

Table 3. RELATIONSHIP OF TEMPERATURE, HOURS OF WETTING AND WEEKS AFTER FULL BLOOM TO SECONDARY APPLE SCAB INFECTION OF FRUIT†

Average Temperature °C	WEEKS AFTER FULL BLOOM 1	5	10	15
	Hours of Wetting for 2% Fruit Infection			
10	12	26	37	45.5
12	10	21.5	31	38
14	8.5	18.5	26.5	32.5
16	7.5	16.0	23	28.5
18	6.5	14.5	20.5	25.5
20	6	13	18.5	23

† *Adapted from Schwabe et al., 1984.*
Cultivars tested were: Golden Delicious, Starking Delicious, Starkrimson Delicious, White Winter Pearmain.

FUNGICIDE APPLICATION

Timing of Sprays

Growers would be wise to invest in reliable weather monitoring equipment for their own orchard. A hygrothermograph recorder for temperature and relative humidity, and a leaf wetness recorder are essential for accurate monitoring of scab infection periods.

Although many agricultural offices maintain weather equipment at various orchard sites, weather and drying conditions can vary significantly from site to site. The difference of one hour of leaf wetness or one degree of temperature between orchards can mean the difference between having a scab infection period or not. Knowing whether or not there has been a scab infection period in your orchard will enable you to better time your sprays to prevent scab, or save you from spraying unnecessarily.

To time the first spray, growers should consider the long-range weather forecast, tree development and variety, and information on the percentage of ascospore release from last year's leaves. Ascospore maturity may vary widely with geographic location. The percentage of ascospore release and stage of maturity is usually monitored on a weekly basis by the Pest Management Advisor or Horticultural Crop Advisor in your area. This information is available on most agriphones.

Summer Sprays

The end of primary scab season usually occurs during mid- to late-June, but this depends on the amount of rainfall received and the rate of breakdown of last season's leaves. Consult the agriphone to determine when the end of the primary scab season occurs. After the end of the primary season has been announced, wait 2 weeks before checking your trees to ensure that scab is not present. It can take up to 14 days for lesions to appear following a scab infection period.

If primary scab has been controlled in your orchard, the rates of fungicides may be reduced, and the interval between sprays may be lengthened for the remainder of the growing season. Growers should be very careful to check the leaves and young fruit thoroughly for the presence of scab lesions before reducing the fungicide spray program. It takes very few lesions to produce a major epidemic later on in the season if leaves and fruits are not protected. Therefore, the best areas to check are the leaves in the top of standard trees, or anywhere else where you feel that spray coverage may not be adequate.

(Continued on page 14)

Table 4. RETENTION, REDISTRIBUTION AND AFTER-INFECTION ("ERADICANT") ACTIVITY OF SOME FUNGICIDES FOR CONTROL OF PRIMARY APPLE SCAB (ASCOSPORE STAGE ONLY)*

Materials	Maximum After-Infection Activity 6°C	12°C	17°C	Retention	Redistribution
Benlate 50 WP (0.5 kg)	48 hr	24 hr	18 hr	Poor-fair	Unknown
Captan 50 WP (2 kg)	48 hr	24 hr	18 hr	Poor-fair	Fair-good
Cyprex 65 WP (0.5 kg)	48 hr	24 hr	18 hr	Good	Good
Dikar WP (2 kg)	48 hr	24 hr	18 hr	Good	Good
Dithane M-45 80 WP (2 kg)	48 hr	24 hr	18 hr	Good	Good
Equal 65 WP (0.5 kg)	48 hr	24 hr	18 hr	Good	Good
Manzate 200 (2 kg)	48 hr	24 hr	18 hr	Good	Good
Phygon 50 WP (0.5 kg)	96 hr	48 hr	36 hr	Poor-fair	Poor-fair
Polyram 80 WP (2 kg)	48 hr	24 hr	18 hr	Good	Good

* *Adapted after New York (Geneva) data. These values were obtained from greenhouse tests; rates quoted are per 1000 L. Rate per hectare is 3 times rate per 1000 L. The after-infection activity of these fungicides may not be adequate to control primary apple scab in a commercial orchard. Be very careful and don't rely heavily on the after-infection activity if the maximum time interval for a given temperature is being reached. The after-infection activity is calculated from the start of the wetting period.*

Note: These results are formulation-specific. Newer formulations of some products (e.g. Dithane DG, Manzate 200 DF, Polyram DF) have not been evaluated. Contact the manufacturer for more information.

If scab lesions are found, you should maintain a full-rate fungicide program for the remainder of the season.

FUNGICIDE PROGRAMS FOR APPLE SCAB CONTROL

Apple scab control spray programs must begin when the first susceptible green tissue emerges from the buds in the spring.

These scab control programs are based primarily upon timing and the type of fungicide being used. There are two general approaches; a **protectant** program, and an after-infection **"eradication"** program.

The significance of the small percentage of ascospores released at night is directly dependent upon the amount of inoculum present on last year's leaves.

Growers who had an unacceptable amount of leaf scab the previous season should rely on a protectant fungicide schedule, rather than using an after-infection "eradication" program.

I. Protectant Program

The basis for this program is the application and maintenance of fungicide material on the expanding foliage prior to the occurrence of infection periods. The program should commence just prior to the first primary infection period (between silver tip and green tip). Apply fungicides at 5-7 day intervals up to First Cover, preferably just prior to each primary infection period. From First Cover until early August, apply fungicides at 10-14 day intervals depending on rainfall frequency. New growth and expanding fruit must be protected and residues washed off by rain must be replaced.

Some fungicides are not readily washed off and the residues are redistributed by rain water. (See Table 4).

II. After-Infection "Eradication" Program

An after-infection spray is one that is applied within a specific time after an infection period has begun. The length of time available to apply the fungicide so that it will work effectively depends on the product being used and the average temperature (see Table 4, page 13). When calculating after-infection activity, you must start counting the time interval from the **beginning** of the **infection** period. For example, at 6°C you would have to apply Captan within 48 hours of the BEGINNING of the **infection** period (please refer to "Determining infection periods" to calculate infection periods).

Do not entirely rely on after-infection fungicide programs to control scab. In order to use this type of spray program successfully, you need spray equipment capable of providing good spray coverage under adverse conditions as well as accurate temperature and leaf wetness information for your individual orchard. Reliable weather monitoring equipment is a must when relying on after-infection (kickback) activity of fungicides to control scab. After-infection sprays are usually considered emergency treatments to be used when the regular protectant program has been weak or ineffective, or scab is present on the trees. However, these programs may be used effectively by some growers on processing and less valuable cultivars.

APPLE SCAB CONTROL UNDER ADVERSE WEATHER CONDITIONS

Several consecutive days of continuous wet conditions and mild temperatures are common in the spring and are very favourable for apple scab infection to take place. It is often difficult to maintain sufficient fungicide on the trees to provide protection for the rapidly expanding foliage and fruit under such conditions.

If you feel your trees are not protected, it is better to apply a fungicide during a break in the rain, or even during a light rain, than not to spray at all. A fungicide having good retentive properties should be used at such times. For example, Manzate 200 has good retention and after-infection activity, while Benlate has good after-infection activity but poor retention when applied to wet trees.

After-infection sprays may be required when protectant fungicides become too diluted to prevent the apple scab fungus from establishing itself on the foliage or fruit. If the time limit for the after-infection activity (kickback) of the fungicide (Table 4, page 13) is exceeded, it may still be worthwhile to apply the fungicide. Benlate can have antisporulant activity beyond the stated "After-infection Activity" period in Table 4. Repeat the application in 4 or 5 days if wet weather persists.

If an infection has occurred, scab lesions should become visible on the foliage and fruit in about 9 days at 20°C or in about 14-21 days if the average temperatures are 12°C or lower.

As soon as tissue infections are visible, they should be controlled by following the instructions outlined in the section following entitled, "Deactivation of Established Scab Lesions".

Strong winds can hamper spraying operations by causing pesticides to drift away from the intended target. Spraying at night, or early in the morning, can help to reduce spray drift. Lowering the spray trajectory into the wind may also help, but growers should take extra care to make sure that the tree tops get good spray coverage.

DEACTIVATION OF ESTABLISHED SCAB LESIONS

Apple scab lesions that are visible on the foliage and fruit contain many spores capable of spreading the disease through secondary infection. The fungicides benomyl (Benlate), thiophanate-methyl (Easout), and dodine (Equal and Cyprex) have demonstrated good anti-sporulant activity EXCEPT WHERE RESISTANCE IS PRESENT.

In the past, growers have been able to obtain control of established apple scab because of the eradicant properties of these fungicides. Both dodine (Cyprex/Equal) and benomyl (Benlate) were effective products for the control of apple scab and because of this, were used intensively in season-long spray programs. Cyprex was used effectively for about 10 years, while Benlate was used only about 3 years before the first cases of resistant scab developed. Scab that is resistant to benomyl is also resistant to thiophanate-methyl (Easout). Resistance was suspected and confirmed after each of these products failed to control apple scab in orchards. A survey of apple scab samples in Ontario showed that about 50% were resistant. Resistance may be present even when these fungicides have never been sprayed. Therefore, the use of these fungicides are *not* encouraged.

Apple growers will have to continue to rely on the use of protectant fungicides to control scab. At this time, there are no alternatives for the eradication of established apple scab, unless growers have scab that is still sensitive to benomyl and thiophanate-methyl, or dodine.

If resistant scab organisms are not present in your orchard and apple scab lesions are visible, you can try to deactivate these tissue infections. Two sprays of benomyl plus a compatible protectant fungicide, or 2 sprays of dodine should be applied at full rate 5-7 days apart as soon as scab lesions are observed. These materials reduce the number of spores produced in the lesions and should help to slow the spread of the disease. These eradicant sprays should be followed up with a regular protectant program.

FIRE BLIGHT OF APPLE AND PEAR

Fire blight can be a major problem for the growers of pears and susceptible apples in Ontario. A number of practices are required in order to reduce blossom and shoot blight on both apples and pears.

All diseased wood should be removed in the dormant season. If new infections have to be removed in the growing season, cut or break out infections at least 30-45 cm below discolored wood using tools disinfected with household bleach (6% sodium hypochlorite) solution (one part bleach in four parts water). Store bleach solution in a closed plastic or glass container. After use, wash tools and oil them to prevent rust. Denatured alcohol (ethanol) is a better disinfectant than the bleach solution and will not rust tools.

In spring, warm tempratures (18°C +) and moisture favor the infection of blossoms. When these conditions are predicted and if they persist through the blossom period, protect the blossoms with streptomycin sulphate (100 ppm)*. **Spraying should be carried out under slow drying conditions for best results.** Protection of the rapidly growing terminals using streptomycin is only recommended during the first 10 days following CALYX in combination with good control of biting and chewing insects.

During the growing season control of insect pests such as aphids, psylla, leafhoppers and plant bugs helps to reduce spread of fire blight from infected to healthy trees. In a non-bearing orchard, Bordeaux (3-5-1000) may be substituted for streptomycin; however, it is less effective than streptomycin in controlling fire blight.

NOTE: EXCESSIVE USE OF STREPTOMYCIN MAY LEAD TO THE DEVELOPMENT OF RESISTANCE IN THE CAUSAL AGENT.

If hail or damaging winds should occur during the growing season, streptomycin should be applied within 24 hours to prevent serious damage to the fruit and trees. Caution is advised to ensure a 30-day to harvest interval on pears and 50-day to harvest interval on apples.

Excessive nitrogen application should be avoided, since it encourages the growth of succulent tissues (such as suckers) and they are more susceptible to fire blight infections.

For best results, ALL these control methods should be carried out to keep fire blight at a manageable level in the orchard. For additional information refer to OMAF publication *Integrated Pest Management for Apple Orchards in Ontario.*

**Agri-Mycin 17*

100 ppm = 600 g product/1000 L water

PHYTOPHTHORA COLLAR ROT CONTROL

Collar rot problems have been experienced in several situations where heavy soil, poor drainage or replanting in old orchard sites occurred. This disease, caused by a long-lived, soil-borne fungus *(Phiophthora cactorum)*, is especially damaging to apple trees grown on M106 rootstock. Trees on M26 and M111 rootstocks are intermediate in susceptibility, while M7A and M9 rootstocks are moderately resistant.

Where concern for collar rot is present before planting, do not use susceptible rootstocks.

For problem areas, Ridomil 240EC is registered for use on NON-BEARING trees only. Apply Ridomil 240EC as a drench to the soil around the base of the tree. Use 4.25 ml in 5 L of water per tree. Make the first application at planting and repeat in late August. In subsequent non-bearing years, apply Ridomil 240EC in the early spring and again in late August. This treatment will suppress fungal growth and development. However, the fungus will survive in the soil. Long-term control should include resistant rootstocks and proper site selection.

BORDEAUX MIXTURE

Generally, Bordeaux sprays are recommended as dormant applications. The lime interacts with the copper sulfate to reduce the burning action (phytotoxicity) that would occur if the copper sulfate were used alone. For this reason, most Bordeaux mixtures are in a ratio of 3 parts lime to 1 part copper sulfate. The copper component provides most of the activity that Bordeaux has on fungal and bacterial diseases **Only certain brands of copper sulphate are registered for this use.** At present, the brands of copper sulphate which are registered for on-farm preparation of Bordeaux mixture include:

NORANDA BLUESTONE SUPERFINE	PCP#15266
CLEAN CROP COPPER 50 W	PCP#9934

BORDEAUX FORMULAS

In any Bordeaux formula, the numbers refer to kilograms of ingredients and any amount of water. These are always listed in the same order with the copper sulfate first, then the lime, and the water last (eg. Bordeaux 4-6-1000 L means 4 Kg of copper sulfate and 6 Kg of lime in 1000 L of water).

NOTE: Bordeaux mixtures are extremely corrosive and, therefore, sprayers should be washed thoroughly after use. A protective coating of oil may help prevent the Bordeaux from bonding to the paint, thus making washing easier.

To Tank-Mix Bordeaux

1. Start water flowing into the spray tank.
2. When the tank is about one-third full and the mechanical agitator is in operation, start washing the powdered copper sulfate into the tank through a screen with water from the supply hose. A wooden spoon is often helpful in working powdered copper sulfate through the screen. The screen is necessary to avoid large granules of copper sulfate from getting into the tank. Pre-mixing copper sulfate with hot water has been shown to help the product dissolve.
3. By the time the tank is two-thirds full, all of the powdered copper sulfate should be in the tank. Then wash the lime (hydrated or builders') through the screen, using the water-supply hose, into the copper sulfate solution in the tank. The lime should be as diluted as possible before it meets the copper sulfate solution in the tank, so use lots of water to wash the lime through the screen. Pre-soaking the lime before adding to the tank may be preferred to washing powdered lime directly through the screen into the tank.
4. Keep the agitator running continuously and apply the Bordeaux mixture immediately. Do not allow the mixture to settle out.

SOLUPAKS, SOLUBAGS, SOLUPOUCHES

To simplify disposal of empty pesticide packages, the industry has re-introduced a soluble package which dissolves in the tank of the farm sprayer. Water soluble packaging under the names of SOLUPAK, SOLUBAGS, SOLUPOUCH or TOSS 'N GO will become more common for dry flowable and wettable powder formulation of pesticides.

In the majority of cases, the water soluble packaging material is PVA (poly vinyl alcohol). This material dissolves completely when added **according to instructions** to the water in the sprayer tank.

The following precautions and instructions regarding handling, mixing and compatibility must be followed for satisfactory use.

HANDLING

1. Do not allow water soluble pouches to become wet prior to adding to the sprayer tank.
2. Do not handle the water soluble pouches with wet hands or wet gloves.
3. Do not remove water soluble pouches from the overwrap (outer package) except when adding directly to the sprayer tank.
4. Always reseal the overwrap bag (outer package of non-soluble material) to protect the remaining pouches from any moisture.

MIXING

1. After sprayer tank is one-quarter full of water (and the agitator is running) add the water soluble pouches to the tank.
2. Depending on the water temperature and the degree of agitation, these pouches should dissolve completely within five minutes.
3. As tank continues to fill, add any other additional compatible pesticides.

(Continued on page 17)

COMPATIBILITY

1. Do not add any other pesticide which is not compatible with the PVA packaging material.
2. The PVA material is **not soluble** with summer type oils (e.g. Superior Oil), or EC formulations containing mineral or vegetable oil products.
3. Do not combine with the pouches, any material containing boron (e.g. "Solubor"), some chelated micronutrients or certain water soluable fertilizers because these compounds are not compatible with PVA film. The combination of these chemicals with PVA film is likely to cause a sticky, insoluble substance in the tank.
4. After applying boron, chelated micronutrients or water soluble fertilizers, completely empty and rinse the spray tank before using any product packaged in PVA.

   Read all labels and instructions carefully; for more details contact your farm chemical dealer.

GUIDE FOR SPRAYING TREE FRUITS

The procedures for efficient use of orchard sprayers are contained in Publication 373, *Orchard Sprayers*. Though this information was derived mostly from apple orchards, the general principles of spray information, and the operation and maintenance of equipment apply equally well to spraying of peaches, pears, plums and cherries. The following points should be stressed:

1. The sprayer must be large enough to cover the orchard in the time available and under adverse conditions.
2. Equipment must be in top condition.
3. Trees must be pruned so that the spray will penetrate easily.
4. Regular checks must be kept on severity of disease, insect pest numbers and stages, and lengths of wetting periods, so that timing will be accurate.
5. The rate of pesticide and the volume of water required will vary depending upon the individual situation. The rates in the spray calendar are based on spraying trees 4.5-5.5 m in height. Trees larger or smaller *MAY* require more or less pesticide. See Table A. As well, the volume of water required to spray the tree will vary because of application equipment, tree size, and target pest. The original so-called "Dilute" rate was based on spraying a standard tree to runoff. For trees 4.5-5.5 m, this is now considered to be 3,000 L/ha. Again, this volume can be adjusted up or down depending upon tree size. See Table A. Many growers successfully adjust rate of pesticide/ha by changing the volume they apply, either by cutting off certain nozzles, or by changing driving speed. This allows greater flexibility in farms with various-sized trees, while maintaining the same amount of chemical put in each full tank of water.

NOTE: Companies are not liable for failure due to use of rates below those recommended on their labels.

TABLE A

Tree Height	Pesticide/ha	Water/ha for Dilute Spraying
6m and over	1 1/3 × recommended rate	4000 L
4.5-5.5m	full recommended rate	3000 L
2.5-3m	2/3 × recommended rate	2000 L

6. Both low-volume applications and low rates of chemical have resulted in increased populations of scales, mites and woolly aphid, especially in tree tops.

   For oil sprays, enough spray liquid must be used to soak the bark completely. When spraying streptomycin for fire blight, higher volumes are also required for maximum absorption of material. Suggested volumes are below.

TABLE B

Water Volumes for Special Pests	
Trees 6m and over	— 4500 L water/ha
Trees 4.5-5.5m	— 4000 L water/ha
Trees 2.5-3m	— 3500 L water/ha

Calibrating the Sprayer

See page 24 of Publication 373, or follow this shortened version.

Refer to Table 5 below on driving time per hectare.

Table 5. SPRAYING TIME PER HECTARE (Without turning & filling time)

Distance between rows (metres)	Tractor Speeds km/hr 1.6	2.4	3.2	4.0	4.8	5.6	6.4
	Time in Minutes to Drive One Hectare						
3.0	125.0	82.5	62.5	50.0	41.25	35.0	31.0
4.6	82.5	55.0	41.25	33.0	27.5	23.5	20.5
6.1	62.5	41.25	31.0	25.0	20.5	17.75	15.5
7.6	50.0	33.0	25.0	20.0	16.5	14.0	12.5
9.1	41.25	27.5	20.5	16.5	13.75	11.75	10.25
10.7	35.25	23.5	17.75	14.0	11.75	10.0	8.75
12.2	31.0	20.5	15.5	12.5	10.25	9.5	7.75

Proceed through the following seven steps:

1. Check tractor speed:

Table 6. TIME REQUIRED TO PASS A NUMBER OF TREES AT DIFFERENT DRIVING SPEEDS

Tractor Speed km/h	IN THE ROW TREE SPACINGS (Metres) 6.1	7.6	9.1	10.0	10.7	12.2
	Time (Seconds) to Pass 10 Trees					
2.4	91	114	136	150	159	182
3.2	68	85	102	112	119	136
4.0	54	68	82	90	95	109
4.8	45	58	70	77	82	94
5.6	39	49	58	64	68	78
6.4	34	43	51	56	60	68

2. Make a sprayer-tank measuring stick marked off in units of 50 L.
3. From the chart find the number of minutes needed to spray a hectare at the speed recommended for your sprayer.
4. Decide how many litres of liquid per hectare you wish to use (considering time available, size of sprayer, size of trees, and time of day spraying will be done).
5. Find the sprayer output required thus:

$$\frac{\text{litres per hectare}}{\text{time per hectare}} = \text{litres per minute (for all nozzles)}$$

6. Divide this output by the number of nozzles:

$$\frac{\text{litres per minute}}{\text{number of nozzles}} = \text{litres per minute per nozzle}$$

7. From manufacturer's chart*, find a nozzle to give this output. Then choose nozzles with smaller outputs for top and bottom positions and larger ones for the upper third of each side. When added, the total output should be close to the value shown in No. 5 (L per min). For small trees, block off one or two of the top nozzles and shut off between trees to prevent waste of spray.

* *Pages 40-47, Publication 373, Orchard Sprayers.*

AIRCRAFT APPLICATION

Aerial applicators must be licenced by the Ontario Ministry of the Environment to apply pesticides. In addition, permits are required from the Ontario Ministry of the Environment under the authority of The Pesticides Act 1973 for the application of Schedule 1 and 5 pesticides, and Schedule 2 hormone-type herbicides. The area will be inspected by Ministry personnel to ensure safety of application.

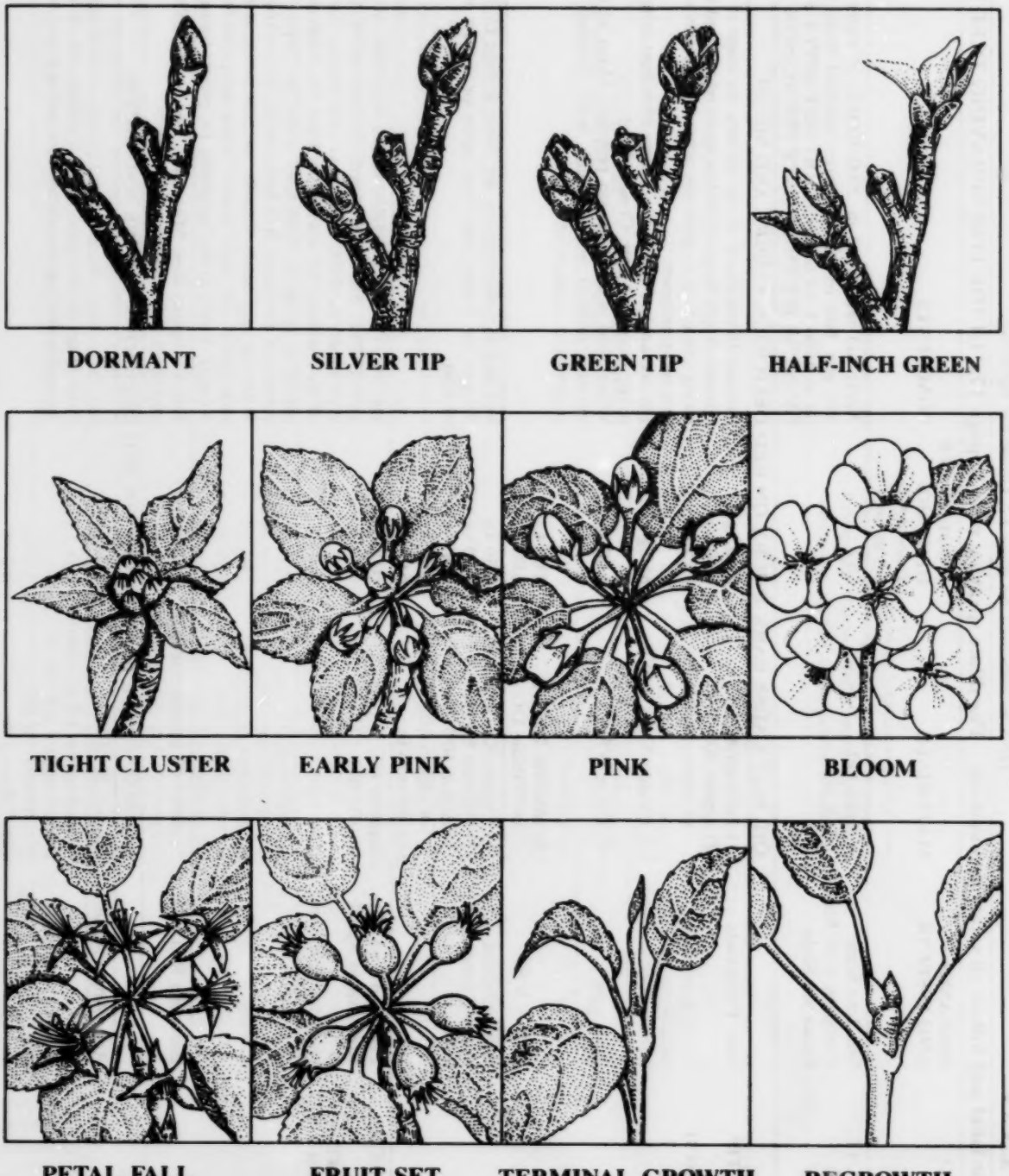
It is an offense under the Federal Pest Control Product Act to use a control product under unsafe conditions. Precautionary practices must be heeded at all times to prevent drift. Extra precautions should be taken when using insecticides applied by air, especially those known to be toxic to honeybees, e.g. Sevin (carbaryl).

Applications should not be made if the wind is blowing. Some drift occurs even on the stillest day. To keep drift to a minimum, apply pesticides in the evening or early morning.

Be sure that the product to be used and its rate of application are specified in the contract.

FIGURE 1. APPLE BUD STAGES

APPLE GROWTH STAGES*



* *With permission of the Michigan Cooperative Extension Service*

APPLES

For trees more than 5.5 m or less than 4.5 m high, adjust rates as indicated on page 17, Guide for Spraying.

Read the label and follow all safety precautions. For dilute spraying refer to page 17, "GUIDE FOR SPRAYING TREE FRUITS".

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE Trees 4.5 to 5.5 m high	COMMENTS
DORMANT	San Jose Scale European Fruit Scale Lecanium Scale	Superior Oil (60-70 vis.)	60 L	Apply full rate of oil in 2000-3000 L of water/ha. 3000 L will give best results. On large standard trees, use 90 L of oil in 4500 L of water/ha. DO NOT APPLY FULL RATE OF OIL MORE THAN ONCE PER SEASON.
		OIL MAY CAUSE BARK INJURY ON RED DELICIOUS, EMPIRE AND MUTSU		
GREEN TIP up to HALF-INCH GREEN	Scab Protectants	(1) Polyram 80 DF (2) captan 50% WP or captan 80% WP	6.00 kg 6.00 kg 3.75 kg	Consult Horticultural Crop Advisor for stage of spore development. Apply fungicide before spore release and keep growing leaves coated. It is generally advisable to alternate materials in a spray program.
		(3) Phygon-XL 50% WP	850 g	Do not apply Phygon for 5 days after frost injury or if there is any danger of frost. Consult label.
		(4) Dikar WP	6.00 kg	When used in a full-season program, Dikar at 6 kg/ha will suppress orchard mites. Higher water volumes aid in mite suppression. Consult label.
		(5) Manzate 200 DF or Dithane DG	6.00 kg 6.00 kg	
	After-infection Spray ("Eradicant")	(1) Phygon-XL 50% WP (2) Polyram 80 DF (3) captan 50% WP or captan 80% WP (4) Dikar WP	1.50 kg 6.00 kg 6.00 kg 3.75 kg 6.00 kg	For after-infection activity, see Table 4, page 13. Do not apply Phygon for 5 days after frost injury or if there is any danger of frost.
HALF-INCH GREEN TO TIGHT CLUSTER	European Red Mite Rosy Apple Aphid	Superior oil (60-70 vis.)	60 L	DO NOT APPLY FULL RATE OF OIL MORE THAN ONCE PER SEASON. Apply full rate of oil in 2000-3000 L of water/ha. 3000 L will give best results. Test the stability of the emulsion by shaking in a jar. On large standard trees, use 90 L of oil in 4500 L of water/ha. Superior oil for the control of European Red Mite should be applied before overwintering eggs hatch. Usually the best timing is between half-inch green and tight cluster when temperatures are getting warmer. Listen to the agriphone for proper timing.
	European Red Mite	Superior oil concentrate	15 L	**For European Red Mite only.** For compatibility with other chemicals consult label.
		OIL MAY CAUSE BARK INJURY ON RED DELICIOUS, EMPIRE AND MUTSU		
	Rosy Apple Aphid	Pirimor 50 WP	1.7 kg	
	Scab	With Superior oil or superior oil concentrate use one of: (1) Polyram 80 DF (2) Dithane DG or Manzate 200 DF	 6.0 kg 6.0 kg 6.0 kg	Add fungicide to tank when 1/4 to 1/2 full of water and mix thoroughly. Add superior oil last when tank is at least 3/4 full of water.

	San Jose Scale European Fruit Scale	Supracide 240 EC	5.8 L	
	Powdery Mildew	Use one of: (1) Dikar WP (2) Karathane 18.25% WD (3) Easout 70% WP plus captan 50% WP (4) Benlate 50% WP plus Polyram 80 DF (5) Benlate 50% WP plus captan 50% WP (6) Benlate 50% WP plus Manzate 200 DF (7) sulphur 92%	 8.40 kg 3.50 kg 625 g 3.25 kg(6.0) 1.10 kg 3.25 kg(6.0) 1.10 kg 3.25 kg(6.0) 1.10 kg 3.25 kg(6.0) 10.0 kg	Where mildew is a problem on varieties such as Idared, Jonathan, Cortland and Tolman Sweet, spray at weekly intervals from bud burst until the terminal buds are formed (usually at second cover). Materials (2) and (7) must be used with one of the scab protectant fungicides for scab control. For scab control with mixtures (3), (4), (5) and (6) use the higher rate in brackets. Do not use sulphur on Delicious.
TIGHT CLUSTER PINK	Tentiform leaf miner	*(1) Ambush 500 EC or Pounce 384 EC *(2) Belmark 300 EC *(3) Decis 2.5 EC *(4) Ripcord 400 EC or Cymbush 12.5% WP	400 mL 520 mL 450 mL 500 mL 250 mL 800 g	Apply thorough spray coverage on trunk and scaffold limbs. Consult agriphone for timing. This treatment will also control early spring-feeding caterpillars and tarnished plant bug. Further treatments with Lannate may be required during the season because the leafminer is now resistant to Guthion, Imidan and Zolone. Consult Horticultural Crop Advisor.
	Scab	Use one of scab protectant fungicides listed at Green Tip. See page 14 for "adverse weather conditions".		
	Cedar Apple Rust Quince Rust	(1) ferbam 76% WDG (2) Dikar WP (3) Polyram DF (4) Dithane DG	2.5 kg 6.0 kg 6.0 kg 6.0 kg	Include in each spray up to and including FIRST COVER.
	Plant Bugs	(1) Cygon 480 E (2) [1]Supracide 240 EC	2.5 L 6.9 L	Where troublesome, add to one spray before bloom. Will also control spring-feeding caterpillars and green fruitworm.
	Spring-feeding caterpillars Green Fruitworm	(1) [2]Guthion 50% WP or [2]APM 50% W [2]Guthion Solupak 50 WP (2) Zolone Flo (3) [1]Supracide 240 EC (4) Imidan 50 WP	2.1 kg 2.1 kg 2.0 kg 2.0 L 6.6 L 3.75 kg	This spray is not necessary if a synthetic pyrethroid was applied for tentiform leafminer.
	Leafrollers	(5) Dipel 50 WP	3.35 kg	(for leafrollers only). Monitoring of Leafroller life stage is recommended since Dipel is most effective on early instars.

[1]Minimum period before reentry is 24 hours.
[2]Minimum period before reentry is 48 hours.
**Repeated applications of synthetic pyrethroids are discouraged.*
See "Pest Resistance", page 10.

APPLES (Continued) **For trees more than 5.5 m or less than 4.5 m high, adjust rates as indicated on page 17, Guide for Spraying.**

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE Trees 4.5 to 5.5 m high	COMMENTS
FULL PINK	Scab	Use one of scab protectant fungicides listed at Green Tip. See page 14 for "adverse weather conditions".		
	European Red Mite	(1) Morestan 25% WP	2.25 kg	Miticides are most effective when used alone. Consult the agri-phone for stage of mite development. Alternate miticides.
		(2) Carzol 92 SP	1.10 kg	Morestan aids in powdery mildew control. Do not use Morestan if oil was used later than HALF-INCH GREEN. Morestan applied
		(3) Omite 30 W	5.50 kg	within 3 days following frost (or near frost weather conditions) or prior to a long wetting period may result in fruit russetting. McIntosh, Spartan and Empire appear to be more susceptible. Carzol is harsh on beneficial mite species and bees. Application before **PETAL FALL** is preferred. Omite works best when the average temperature is above 21°C.
		RESISTANCE TO MITICIDES IS INCREASING IN ONTARIO ORCHARDS. SEE "PEST RESISTANCE" PAGE 10.		
	Rosy Apple Aphid	(1) Pirimor 50% WP	1.70 kg	Preferred time for control. See note on bee toxicity, page 9.
		(2) Zolone Flo	2.00 L	
		(3) Cygon 480 E	3.75 L	Cygon may cause russetting.
		(4) [1]Supracide 240 EC	6.60 L	
BLOOM PERIOD		**DO NOT APPLY INSECTICIDES WHILE APPLE TREES ARE IN BLOOM.** See page 9.		
	Scab	Use one of protectant fungicides listed at Green Tip. See page 14 for "adverse weather conditions". Do not apply Phygon-XL at the full eradicant rate (1.75 kg/ha) during bloom.		
	Fire Blight	Agri-Mycin 17	600g/1000 L	High-volume spraying preferable. Use alone for best results. Maintain coverage on newly opening blossoms. See page 15.
	POLLINATION	**Most varieties are commercially self-unfruitful and require mixed variety plantings and insects for cross-pollination. Honeybees find apple blossoms attractive. See page 8 and OMAF Publications 71 and 72. Remove bees before applying CALYX spray.**		
PETAL FALL (CALYX) When most petals have fallen	Scab	Use one of the fungicides recommended in the GREEN TIP to HALF-INCH GREEN (except Phygon).		
	Tentiform leafminer	[1]Lannate L	6.75 L	Apply when the first tissue feeding mine is seen on the upper surface of cluster leaves. Do not apply to Early McIntosh or Wealthy apple varieties.
	Rosy Apple Aphid	(1) Pirimor 50% WP	1.70 kg	
		(2) Zolone Flo	2.00 L	
		(3) Cygon 480 E	3.75 L	Cygon may cause russetting.
		(4) [1]Supracide 240 EC	6.60 L	Also controls oystershell scale.
	Mullein Leaf Bug	(1) diazinon 50% WP	3.25 kg	Timing is critical. Contact your Pest Management Specialist or Horticultural Crop Advisor prior to spray application if mullein bugs are numerous, or if orchard has had this problem in the past.
		*(2) Belmark 300 EC	450 mL	
		(3) [1]Lannate L	6.75 L	
		*(4) Ambush 500 EC	400 mL	
		*(5) Decis 2.5 EC	400 mL	

	Oystershell Scale	(1) [2]Guthion 50% WP or [2]Guthion Solupak 50 WP (2) [1]Supracide 240 EC	2.1 kg 2.0 kg 6.6 L	Apply as soon as petals are off.
	Plum Curculio Caterpillars	(1) [2]Guthion 50% WP or [2]APM 50% W or [2]Guthion Solupak 50 WP (2) Imidan 50% WP (3) Zolone Flo *(4) Ambush 500 EC or Pounce 384 EC *(5) Belmark 300 EC *(6) Ripcord 400 EC or Cymbush 12.5% WP	2.10 kg 2.10 kg 2.00 kg 3.75 kg 3.00 L 400 mL 520 mL 450 mL 250 mL 800 g	
	European Red Mite	(1) Apollo SC (2) Carzol 92 SP	300 mL 1.1 kg	Apollo kills mite eggs. Apply when mites are mostly in the egg stage, and before there are more than 3 active mites per leaf. Thorough coverage is essential for good control. Apply Apollo alone in a minimum of 1100 L of water per hectare. Make no more than 1 application per year. Carzol is harsh on beneficial mite species and bees.
	Powdery Mildew	Use one of the fungicides listed at Half-Inch Green to Tight Cluster.		
FIRST COVER 7 to 10 days after CALYX	Scab	See page 14 for "adverse weather conditions". Use one of fungicides recommended at Green Tip except Phygon.		An extra scab spray may be required between **CALYX** and **FIRST COVER** spray.
	Plum Curculio	Use one of the insecticides listed under PETAL FALL (CALYX).		
	Fireblight	Agri-Mycin 17	600 g/1000 L	To control shoot blight especially if blossom blight has occurred.
	European Red Mite Two-spotted Spider Mite	(1) Apollo SC (2) Kelthane AP-35 (3) Omite 30 W	300 mL 4.50 kg 5.50 kg	Apply no later than 14 days after petal fall. Apollo kills mite eggs. Apply when mites are mostly in the egg stage and before there are more than 3 active mites per leaf. Thorough coverage is essential for good control. Apply Apollo alone in a minimum of 1100 L of water per hectare. Make no more than 1 application of Apollo per year. Omite works best when the average temperature is above 21°C. Kelthane should not be used more than once a year to delay the development of resistance. See "Pest Resistance", page 10. If this was your first mite spray a repeat application with an alternate miticide may be necessary in 14 days. Miticides are best used alone.

RESISTANCE TO MITICIDES IS INCREASING IN ONTARIO ORCHARDS. SEE "PEST RESISTANCE", PAGE 10.

[1]Minimum period before reentry is 24 hours.
[2]Minimum period before reentry is 48 hours.
**Repeated applications of synthetic pyrethroids are discouraged.*
See "Pest Resistance", page 10.

APPLES (Continued) **For trees more than 5.5 m or less than 4.5 m high, adjust rates as indicated on page 17, Guide for Spraying.**

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE Trees 4.5 to 5.5 m high	COMMENTS
FIRST COVER (Continued)	Rosy Apple Aphid	(1) Pirimor 50% WP	1.70 kg	
		(2) Zolone Flo	2.00 L	
		(3) Cygon 480 E	3.75 L	Cygon may cause russetting.
		(4) [1]Supracide 240 EC	6.60 L	Also controls oystershell scale.
	Powdery Mildew	Use one of the fungicides listed under Half-Inch Green to Tight Cluster.		
SECOND COVER	Scab	Use one of the fungicides recommended at Green Tip except Phygon.		
	Codling Moth	(1) Imidan 50% WP	3.75 kg	
		(2) [2]Guthion 50% WP	2.10 kg	Guthion and APM also control scale crawlers.
		or [2]APM 50% W	2.10 kg	
		or [2]Guthion Solupak 50 WP	2.00 kg	
		(3) Zolone Flo	2.00 L	Zolone also controls aphids.
		(4) Sevin 50% WP	3.00 kg	
		*(5) Ambush 500 EC	400 mL	
		or Pounce 384 EC	520 mL	
		*(6) Belmark 300 EC	350 mL	
		*(7) Ripcord 400 EC	250 mL	
		or Cymbush 12.5% WP	800 g	
		*(8) Decis 2.5 EC	400 mL	
	Green Apple Aphid Rosy Apple Aphid	Add one if aphids are abundant:		Diazinon, Cygon and Zolone will also control Codling Moth. Pirimor will also control White Apple Leafhopper. Zolone will also control Woolly Apple Aphid.
		(1) Pirimor 50% WP	1.70 kg	
		(2) Zolone Flo	2.00 L	Cygon may cause russetting.
		(3) Cygon 480 E	3.75 L	Thiodan, Thionex may also control White Apple Leafhopper. Check the label for recommended rate.
		(4) Thiodan, *or* Thionex 50% WP	3.25-4.5 kg	
		(5) diazinon 50% WP	3.25 kg	
THIRD COVER 10 days later	Scab	(1) Polyram 80 DF	6.0(4.5) kg	If scab is controlled in your orchard, use the lower rate given in brackets.
		(2) captan 50% WP	6.0(3.0) kg	
		or captan 80% WP	3.75(2.0) kg	
		(3) Dikar WP	6.0(5.0) kg	
		(4) Manzate 200 DF	6.0(4.5) kg	
		or Dithane DG 80%	6.0(4.5) kg	
	Codling Moth Apple Maggot	Use one of:		
		(1) Imidan 50 WP	3.75 kg	
		(2) [2]Guthion 50 WP	2.1 kg	
		or [2]APM 50 W	2.1 kg	
		or [2]Guthion Solupak 50 WP	2.0 kg	
		(3) Zolone Flo	3.0 L	
		(4) Cygon 480 E	4.25 L	Cygon may not give sufficient apple maggot control for fresh market apples, and may cause russetting.
		(5) Sevin 50 WP	6.0 kg	

		(6) diazinon 50% WP	3.25 kg	
		*(7) Ambush 500 EC	400 mL	
		or Pounce 384 EC	520 mL	
		*(8) Belmark 300 EC	350 mL	
		*(9) Ripcord 400 EC	250 mL	
		or Cymbush 12.5 WP	800 g	
		*(10) Decis 2.5 EC	400 mL	
	Green Apple Aphid	**See under SECOND COVER.**		
	DO NOT SPRAY CLOSER TO HARVEST THAN THE NUMBER OF DAYS GIVEN IN TABLE 22, PAGE 89.			
FOURTH COVER **10 days later**	Scab	Use one of the fungicides recommended for **THIRD COVER.**		
	Codling Moth Apple Maggot	Use one of the insecticides recommended for **THIRD COVER.** For early apple varieties, observe the days to harvest interval. See Table 22, page 89.		
FIFTH COVER **10 days later**	Scab	Use one of the fungicides recommended for **THIRD COVER.**		
	Codling Moth Apple Maggot	(1) Imidan 50% WP	3.75 kg	
		(2) [2]Guthion 50% WP	2.10 kg	
		or [2]APM 50% W	2.10 kg	
		or [2]Guthion Solupak 50 WP	2.00 kg	
		(3) Zolone Flo	3.00 L	
		(4) Sevin 50% WP	6.75 kg	
		(5) diazinon 50% WP	3.25 kg	
		*(6) Ambush 500 EC	400 mL	
		or Pounce 384 EC	520 mL	
		*(7) Ripcord 400 EC	250 mL	
		or Cymbush 12.5% WP	800 g	
		*(8) Decis 2.5 EC	400 mL	
SIXTH COVER **10 days later**	Scab	Use one of the fungicides recommended for **THIRD COVER.**		
	Codling Moth Apple Maggot	Use one of the insecticides recommended for **FIFTH COVER.**		
	Sooty Blotch Fly Speck	(1) captan 50% WP	6.00 kg	Repeat application of captan in two weeks. Both captan and Benlate will control Bull's Eye Rot. All materials provide some protection against other storage rots.
		or captan 80% WP	3.75 kg	
		(2) Benlate 50% WP plus	550 g	
		captan 50% WP	3.25 kg	
		(3) zineb 80% WP	4.25 kg	
		(4) Folpan 50% WP (Phaltan)	6.00 kg	
SEVENTH COVER	Pinpoint Scab and Storage Scab	Use one of the fungicides recommended for **THIRD COVER.** Do not use fungicides closer than the stated preharvest interval.		

[1]Minimum period before reentry is 24 hours.
[2]Minimum period before reentry is 48 hours.
**Repeated applications of synthetic pyrethroids are discouraged.*
See "Pest Resistance", page 10.

APPLES (Continued)

For trees more than 5.5 m or less than 4.5 m high, adjust rates as indicated on page 17, Guide for Spraying.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE Trees 4.5 to 5.5 m high	COMMENTS
SEVENTH COVER (Continued)	Second Brood Codling Moth and Apple Maggot	Use one of the insecticides recommended for **FIFTH COVER.**		
SPECIAL SPRAYS	White Apple Leafhopper	(1) Pirimor 50% WP	1.70 kg	Spray when large numbers of nymphs (2-5 per leaf) are observed. Control of adults is very difficult.
		(2) Carzol 92 SP	1.10 kg	
		(3) Sevin 50% WP	3.25 kg	
		(4) Thiodan, *or* Thionex 50 WP	3.25 kg	
	Bud Moth Redbanded Leafroller	(1) [2]Guthion 50% WP	2.10 kg	See above for Codling Moth and Apple Maggot control.
		or [2]APM 50% W	2.10 kg	
		or [2]Guthion Solupak 50 WP	2.00 kg	
		(2) Imidan 50% WP	3.75 kg	Do not use parathion on McIntosh, Cortland, Empire and Melba.
		(3) [3]parathion 15% WP	5.00 kg	
	Woolly Apple Aphid	(1) Pirimor 50% WP	1.70 kg	High volumes of water are recommended. Spray coverage of trunk and scaffold limbs is essential. Repeat application in 14 days if Woolly Apple Aphid is still present. Zolone is effective only if it is used in a cover spray program. Pirimor will also control White Apple Leafhopper.
		(2) malathion 25% WP	6.75 kg	
		(3) Zolone Flo	2.00 L	
		(4) Thiodan, *or* Thionex 50 WP	4.25 kg	
	European Red Mite Two-spotted Spider Mite Rust Mite	(1) Kelthane AP-35	4.50 kg	Kelthane should not be used more than once a year to delay the development of resistance. See "Pest Resistance", page 10. Carzol is harsh on beneficial mite species. Omite works best when the average temperature is above 21°C. Miticides are best used alone. Alternate miticides.
		or Kelthane 187.5 EC	7.50 L	
		(2) Carzol 92 SP	1.10 kg	
		(3) Omite 30 W	5.50 kg	
	RESISTANCE TO MITICIDES IS INCREASING IN ONTARIO ORCHARDS. SEE "PEST RESISTANCE", PAGE 10.			
	Tentiform leafminer	(1) [1]Lannate L	6.75 L	Apply Lannate when new mines show on the lower leaf surface and the first tissue feeder is seen. Do not apply Lannate to Early McIntosh or Wealthy. Use of synthetic pyrethroids for summer generations of tentiform leafminer is not encouraged. Pyrethroids will not give effective control of larvae within the mines. Consult the Pest Management Advisor or Horticultural Crop Advisor. Belmark should not be used within 60 days of harvest.
		*(2) Ambush 500 EC	400 mL	
		or Pounce 384 EC	520 mL	
		*(3) Belmark 300 EC	450 mL	
		*(4) Decis 2.5 EC	500 mL	
		*(5) Ripcord 400 EC	250 mL	
		or Cymbush 12.5% WP	800 g	
	Dogwood Borer Apple Bark Borer	*Ambush 500 EC plus Superior oil	170 mL/1000 L 20 L/1000 L	Soak the trunk. Make 2 applications at 2-3 week intervals when adults are flying (late June to early August). Consult Horticultural Crop Advisor.

[1]Minimum period before reentry is 24 hours.
[2]Minimum period before reentry is 48 hours.
[3]Minimum period before reentry is 7 days.
****Repeated applications of synthetic pyrethroids are discouraged. See "Pest Resistance", page 10.***

GUIDELINES FOR PROTECTING YOUNG NON-BEARING APPLE PLANTINGS

The following program is designed to offer **limited protection when needed for newly planted trees.** It is not intended to be used for protection of bearing orchards. Other protective measures include removal of neglected fruit trees in the area, careful selection of intercrops (where used) and a clean, weed free environment. Rates are for dilute spraying. **Alternate materials are available as shown in the calendar for bearing fruits.**

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER 1000 L	COMMENTS
EARLY SPRING	Phytophthora Collar Rot			See page 16.
FIRST SPRAY	Scab Powdery Mildew Cedar Apple Rust	Dikar WP	2 kg	When green tissue shows. Repeat at 7 to 10 day intervals if wet weather occurs until late June.
PREBLOOM	Tentiform Leafminer	*Synthetic Pyrethroid	—	See section for bearing apples, Tentiform leafminer, page 21. Consult label for rates.
	Leaf-feeding Insects	Imidan 50% WP	1.25 kg	Before blossoms open in bearing orchards. Apply when caterpillars are small. Include with one of fungicide sprays. Not necessary if synthetic pyrethroid was used for tentiform leafminer.
BLOOM	Fire Blight	Agri-Mycin 17	600 g	Avoid overstimulating growth. See page 15.
SUMMER SPRAYS	Leaf-feeding Insects	Imidan 50% WP	1.25 kg	This spray will also control potato leafhopper.
	Aphids Leafhoppers	(1) Pirimor 50% WP (2) Cygon 480 E (3) Metasystox R 240 SC	500 g 1.25 L 1.50 L	Spray if insects become abundant at any time. **Metasystox is not registered for leafhopper control on apples.**
	Tentiform Leafminer	[1]Vydate L	3.0 L	Vydate is very toxic to applicator. Timing is critical. If mines are visible on underleaf surface, consult Horticultural Crop Advisor or Pest Management Advisor prior to use.
	Mites	(1) Morestan 25% WP (2) Omite 30 W	625 g 1.25 kg	Check foliage frequently for mite injury. Spray if more than 7-10 mites/leaf are observed or at first sign of leaf bronzing. Omite works best when the average temperature is above 21°C. Morestan will also help control powdery mildew.
	Buffalo Treehopper			Follow clean cultivation or remove legumes from cover crop.
	Phytophthora Collar Rot			See page 16.
	Root Lesion Nematode: See page 80 for Postplanting Treatment for nematodes on **NON-BEARING** apples.			

[1]Minimum period before reentry is 24 hours.
**Repeated applications of synthetic pyrethroids are discouraged.*
See "Pest Resistance", page 10.

APRICOTS

Read the label and follow all safety precautions.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER 1000L	AMOUNT PER HECTARE	COMMENTS
DORMANT In late March or early April before buds swell	European Red Mite	Superior oil (see notes)	20 L	60 L	Rate per 1000 L is based on 11.4 to 13.6 L of spray per mature tree.
PREBLOOM When blossom buds show pink	Brown rot Blossom blight	captan 50% WP or captan 80% WP	2.00 kg 1.25 kg	6.00 kg 3.75 kg	Apricots are extremely susceptible to brown rot at blossom time and just before picking.
SHUCK-SPLIT When about 50% of shucks have split	Brown rot Plum Curculio	Use one of the fungicides listed under **PREBLOOM.** Add one of: (1) [2]Guthion 50% WP or [2]Guthion Solupak 50 WP (2) [3]parathion 15% WP (3) Sevin 50% WP	 625 g 625 g 1.5 kg 2.0 kg	 2.0 kg 2.0 kg 4.5 kg 6.0 kg	Apricots are extremely susceptible to brown rot. See notes on bee toxicity, page 9.
SHUCK-FALL 10 to 12 days after last spray	Brown rot Plum Curculio	Use same materials as for **SHUCK-SPLIT.**			For peach tree borer, refer to treatment as for peaches.
FIRST COVER 10 to 12 days after **SHUCK-FALL**	Plum Curculio	Use one of the materials given for Curculio at **SHUCK-SPLIT.**			
The addition of Benlate 50% WP at 850 g to captan 50% WP at 4 kg will improve brown rot control only where the fungus is not resistant to Benlate.					
PRE-PICK HARVEST	Brown rot	Use one of the fungicides listed under **PREBLOOM.**			Apricots are extremely susceptible to brown rot just before picking. Additional sprays may be required during harvest if conditions are wet.

[2]Minimum period before reentry is 48 hours.
[3]Minimum period before reentry is 7 days.

Notes:

RED MITE: Where this mite has been a problem add Superior oil 20 L to each 1000 L in the **DORMANT SPRAY;** and in the **PREBLOOM** or at **SHUCK-SPLIT,** spray with one of Kelthane AP-35 1.1 kg/1000 L or Kelthane 187.5 EC 2.5 L/1000 L; or Omite 30 W 2.25 kg/1000 L.

POLLINATION: Most varieties are self fruitful and may be planted in solid blocks. Since this crop blooms early when the weather is often unreliable, it is advisable to provide honeybees to assist in pollen transfer. See OMAF publication 72, "Pollination: Crops and Bees".

VERTICILLIUM WILT: Do not plant following tomatoes, strawberries, potatoes, eggplants or peppers. Also do not interplant with these crops.
BACTERIAL SPOT: There is no satisfactory chemical control. Planting resistant cultivars is recommended.

BLUEBERRIES

Read the label and follow all safety precautions. Do not use Guthion or APM in backpack or home garden-type sprayers. Under MATERIALS, below, the number in brackets refers to the "days to harvest" requirement. For explanation, see page 89. Insect and disease pests occur sporadically in blueberry plantings across Ontario. If a specific pest has previously been a problem, apply controls as described in this calendar.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	COMMENTS
BUD BREAK and REPEAT 10-14 DAYS LATER	*Monilinia* Mummy Berry	Funginex 190 EC (60 days)	1.70 L	Apply Funginex if mummy berry has been a problem.
POLLINATION: Insects such as honeybees are necessary for pollination. See page 8 for ways to reduce bee poisoning, and Publication 71, Honeybees and Pesticides.				
FIRST BLOOM	*Botrytis* Twig and Blossom Blight Fruit Rot	(1) captan 50 WP (2 days) or captan 80 WP (2 days) (2) Dyrene 50 WP (14 days) (3) Ferbam WDG (40 days)	3.25 kg 2.25 kg 3.25 kg 3.75 kg	Fungicide sprays for *Botrytis* are more important when wet weather occurs. Repeat at 7-10 day intervals through bloom if wet. Dyrene is also registered for control of anthracnose fruit rot at 4.4 kg/ha. Ferbam will help control *Monilinia*. Do not use ferbam later than mid-bloom.
PETAL FALL and REPEAT 10-14 DAYS LATER	Cherry Fruitworm Cranberry Fruitworm	(1) [2]Guthion 50 WP (14 days) or [2]APM 50 W (14 days) or [2]Guthion Solupak 50 WP (14 days) (2) malathion 25 WP (1 day) (3) Sevin 50 W (1 day)	1.10 kg 1.10 kg 1.10 kg 2.25 kg 3.25 kg	Guthion or APM will also control Plum Curculio. Malathion will also control aphids. Do not apply insecticides if bees are present.
FRUIT RIPENING	Fruit Rot *(Botrytis)*	(1) captan 50 WP (2 days) or captan 80 WP (2 days)	3.25 kg 2.25 kg	Applications at 7-10 day intervals may be required if blossom blight phase of *Botrytis* was not controlled.
	Fruit Rot *(Anthracnose)*	Dyrene 50 WP (14 days)	4.40 kg	Apply at 7-10 day intervals if anthracnose appears on berries.
SPECIAL SPRAYS	Leaf tiers	*Decis 2.5 EC (14 days)	300 mL	Apply in the bud cluster stage (just prior to leaf bud opening).

[2]Minimum period before reentry is 2 days.
****Repeated applications of synthetic pyrethroids are discouraged.***
See "Pest Resistance", page 10.

NOTE: Stem cankers caused by Fusicoccum and Phomopsis can girdle blueberry canes, resulting in the canes wilting and dying. Prune out and burn diseased canes as soon as they appear.

SWEET CHERRIES

Read the label and follow all safety precautions. For dilute spraying refer to page 17, "GUIDE FOR SPRAYING TREE FRUITS".

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	COMMENTS
DORMANT In spring when buds are dormant	Black Cherry Aphid	Elgetol (DNOC liquid)	12.5 L	If dormant spray could not be applied before buds start moving, use one of the alternate materials at pedal fall when buds are partially open.
DO NOT APPLY INSECTICIDES WHEN CHERRY TREES ARE IN BLOOM. See note on pollination, page 8 and also OMAF Publication 71, *"Honey Bees and Pesticides"*.				
BLOOM	Brown Rot (stem rot and blossom blight stages)	(1) captan 50% WP or captan 80% WP (2) Phygon-XL 50% WP (3) Funginex 190 EC (4) Rovral 50% WP (5) sulphur 92% WP	9.00 kg 5.50 kg 1.75 kg 2.50 L 1.75 kg 27.00 kg	Blossom blight is favoured by wet, warm, (above 16 degrees) weather, and especially when large numbers of mummies are present in the trees. Apply first spray just before blossoms open, followed by two additional sprays during the bloom period if weather remains favourable for blight. Do not use Phygon or Captan within 14 days of an application of superior oil. Rovral provides 24-48 hours kickback activity against blossom blight infections. Funginex also has some eradicant activity, although not as great as Rovral. DO NOT APPLY ROVRAL more than 2 times per season and never in consecutive sprays.
PETAL FALL	Black Cherry aphid	(1) diazinon 50% WP (2) Thiodan 50% WP *or* Thionex 50 WP (3) Zolone Flo	4.00 kg 4.50 kg 4.50 kg 2.75 L	A temperature of at least 21°C, thorough coverage and a calm day are needed for effective aphid control. Usually 1 to 2 sprays are required.
SHUCK FALL	Plum Curculio	(1) [2]Guthion 50% WP or [2]APM 50% W or [2]Guthion Solupak 50 WP (2) Zolone Flo	2.75 kg 2.75 kg 2.75 kg 2.75 L	Spray when most of the shucks are off and plum curculio activity is observed, usually when temperatures are above 16°C. Zolone also helps control aphids.
	Brown Rot	Add one of: (1) captan 50% WP or captan 80% WP (2) Rovral 50% WP (3) sulphur 92% WP	 9.00 kg 5.50 kg 1.75 kg 27.00 kg	 Do not apply Rovral more than 2 times per season, and never in consecutive sprays.
FIRST COVER 12 days after SHUCK FALL	Plum Curculio	Use one of the insecticides listed under SHUCK FALL.		Zolone helps control aphids but is only fair against plum curculio. Monitor 7 days AFTER SHUCK FALL INSECTICIDE FOR NEW PLUM CURCULIO DAMAGE. IF NEW CRESCENT-SHAPED CUTS ON FRUIT ARE FOUND, APPLY.
	Brown Rot	**Use one of the fungicides listed under SHUCK FALL.**		
SECOND COVER 12 days after FIRST COVER	Cherry Fruit Fly Plum Curculio	(1) [2]Guthion 50% WP or [2]APM 50% W or [2]Guthion Solupak 50 WP (2) diazinon (3) Zolone Flo	2.75 kg 2.75 kg 2.75 kg 4.00 kg 2.75 L	On early varieties, check interval from last spray to harvest date. See page 89. Spray when early varieties are beginning to colour. Diazinon does not adequately control curculio. Zolone provides 12-14 days protection against cherry fruit fly, while Diazinon provides 10 days.

	Brown Rot	Add one of:		
		(1) captan 50% WP	9.00 kg	
		or captan 80% WP	5.50 kg	
		(2) Rovral 50% WP	1.75 kg	Do not apply Rovral more than 2 times per season, and never
		(3) sulphur 92% WP	27.00 kg	in consecutive sprays.
THIRD COVER	Cherry Fruit Fly	(1) Sevin 50% WP	9.00 kg	Sevin provides 5-7 days protection.
		(2) Zolone Flo	2.75 L	Check interval to harvest before spraying early maturing Sweet
		(3) diazinon 50% WP	4.00 kg	Cherry. See page 89.
	Brown Rot	Add one of the fungicides listed under **SECOND COVER.**		
PRE-PICK	Brown Rot	(1) Rovral 50% WP	1.75 kg	Spray each variety just before picking.
		(2) Captan 50% WP	9.00 kg	
		or Captan 80% WP	5.50 kg	
		(3) sulphur 92% WP	27.00 kg	
POSTHARVEST ON FRUIT	Rhizopus Rot (black whiskers)	Botran 50% WP	875 g per 500 L water	Dip harvested cherries in suspension of Botran and keep the mixture well agitated during use. Read directions on label.
POSTHARVEST	Leaf Spot	(1) Cyprex 65% WP	2.25 kg	Only necessary where leaf spot is a problem, or where sweet
		or Equal 65% WP	2.25 kg	cherries are beside sour cherries.
		(2) captan 50% WP	9.00 kg	
		or captan 80% WP	5.50 kg	
		(3) ferbam 76% WDG	9.00 kg	
		(4) Benlate 50% WP plus	1.10 kg	
		captan 50% WP	4.50 kg	
	Bacterial Canker		**Materials for 1000 L of dilute spray (use 3000 L/ha for medium-sized tree)**	
First Spray – 3rd week in September		copper sulfate	4 kg	Consult page 16 for information on how to mix Bordeaux.
		spray lime	6 kg	
Second Spray – 14 days later		copper sulfate	4 kg	
		spray lime	6 kg	
Third Spray – 14 days later		copper sulfate	6 kg	
		spray lime	9 kg	
Fourth Spray – 14 days later		copper sulfate	10 kg	
		spray lime	15 kg	
Spring Spray – before bud swell		copper sulfate	6 kg	
		spray lime	9 kg	

Notes:
NEMATODES: See page 79 for methods of controlling nematodes when replanting old tree sites or whole orchards.

[2]***Minimum period before reentry is 48 hours.***

SOUR CHERRIES

Read the label and follow all safety precautions. For dilute spraying refer to page 17, "GUIDE FOR SPRAYING TREE FRUITS".

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	COMMENTS
PREBLOOM	European Red Mite	(1) Superior oil	60 L	Only needed in sour cherry orchards with a heavy mite population. Spray as buds are breaking. Apply oil at 3000 L/ha (dilute rate).
		(2) Morestan 25% WP	2.25 kg	
DO NOT APPLY INSECTICIDES WHEN CHERRY TREES ARE IN BLOOM. See note on pollination, page 8 and also OMAF Publication 71, *"Honey Bees and Pesticides"*.				
BLOOM	Brown Rot (stem rot and blossom blight stages)	(1) captan 50% WP	6.75 kg	Spray just before blossoms open. If wet weather prevails, this spray should be repeated. Do not use Phygon or captan following oil. Funginex has good eradicant activity. See note "Funginex" page 11.
		or captan 80% WP	4.25 kg	
		(2) Phygon-XL 50% WP	1.75 kg	
		(3) Funginex 190 EC	2.50 L	
		(4) Rovral 50% WP	1.50 kg	DO NOT APPLY ROVRAL more than 2 times per season and never in consecutive sprays.
		(5) sulphur 92% WP	20.25 kg	
PETAL FALL	Leaf Spot	(1) Cyprex 65% WP	2.25 kg	Spray only if rain is forcast between **BLOOM** and **SHUCK** sprays.
		Equal 65% WP	2.25 kg	
		(2) captan 50% WP	6.75 kg	
		or captan 80% WP	4.25 kg	
		(3) Benlate 50% WP plus	850 g	
		captan 50% WP	3.25 kg	
		(4) ferbam 76% WDG	6.00 kg	
SHUCK	Plum Curculio	(1) [2]Guthion 50% WP	2.00 kg	Spray when most of the shucks are off and plum curculio activity is observed.
		or [2]APM 50% W	2.00 kg	
		or [2]Guthion-Solupak 50 WP	2.00 kg	
		(2) Zolone Flo	2.00 L	Zolone also helps control aphids.
		(3) Imidan 50% WP	3.75 kg	
	Brown Rot	Add one of:		
		(1) captan 50% WP	6.75 kg	
		or captan 80% WP	4.25 kg	
		(2) Rovral 50% WP	1.50 kg	Do not apply Rovral more than 2 times per season, and never in consecutive sprays.
	Leaf Spot	Use one of the fungicides recommended at **PETAL FALL** with the exception of ferbam.		
	European Red Mite	(1) Kelthane AP 35	4.50 kg	Thorough coverage is necessary for good mite control. Only needed in heavily infested Sour Cherry orchards.
		or Kelthane 187.5 EC	8.50 L	

FIRST COVER 12 days after **SHUCK**	Plum Curculio	Use one of the insecticides listed under **SHUCK.**		Monitor 7 days after shuck fall insecticide for new plum curculio damage. If cresent shape cuts on fruit are found, then apply. Zolone helps control aphids.
	Leaf Spot	Use one of the fungicides listed under **PETAL FALL** with the exception of ferbam.		
SECOND COVER 12 days after **FIRST COVER**	Cherry Fruit Fly Plum Curculio	(1) [2]Guthion 50% WP or [2]APM 50% W or [2]Guthion Solupak 50 WP (2) diazinon (3) Zolone Flo (4) Imidan 50% WP	2.00 kg 2.00 kg 2.00 kg 3.00 kg 2.00 L 3.75 kg	On early varieties, check interval from last spray to harvest date. See page 89. Spray when early varieties are beginning to colour. Diazinon does not adequately control curculio. Zolone provides 12-14 days protection against cherry fruit fly while Diazinon provides 10.
	Leaf Spot	Use one of the fungicides as recommended at **PETAL FALL** with the exception of ferbam.		
	Powdery Mildew	(1) Benlate 50% WP (2) sulphur 92% WP	1.1 kg 10.0 kg	Sulphur at this rate will suppress powdery mildew. Higher rates may cause injury.
THIRD COVER	Cherry Fruit Fly	(1) Sevin 50% WP (2) Imidan 50% WP (3) Zolone Flo (4) diazinon 50% WP	6.75 kg 3.75 kg 2.00 L 3.00 kg	Spray Sour Cherries about the time Montmorency is turning pink. Sevin provides 5-7 days protection.
	Leaf Spot	Add one of the fungicides listed under **PETAL FALL.**		
PREHARVEST	Brown Rot	Add one of the fungicides listed under **SHUCK.**		
The addition of Benlate 50% WP at 850 g to captan 50% WP at 4.25 kg/ha will improve brown rot control only where the fungus is not resistant to Benlate.				
POSTHARVEST	Leaf Spot	(1) Cyprex 65% WP or Equal 65% WP (2) captan 50% WP or captan 80% WP (3) ferbam 76% WDG (4) Benlate 50% WP plus captan 50% WP	2.25 kg 2.25 kg 6.75 kg 4.25 kg 6.75 kg 850 g 3.25 kg	Necessary where leaf spot is a problem.
	Powdery Mildew	(1) Benlate 50% WP	1.10 kg	
	European Red Mite	(1) Morestan 25% WP (2) Omite 30W (3) Kelthane AP-35 or Kelthane 187.5 EC	1.75 kg 5.00 kg 4.50 kg 8.50 L	If mites can easily be found on the leaves at this time, add a miticide with your fungicide application. Do **NOT** mix Morestan with any other product.

[2]Minimum period before reentry is 48 hours.

Notes:

NEMATODES: See page 79 for methods of controlling nematodes when replanting old tree sites or whole orchards.

PEACH TREE BORER: Where a problem, spray as directed for **PEACH** (page 43).

APHIDS: In sour cherry orchards where black cherry aphids are regularly a problem, apply the dormant spray recommended for Sweet Cherries. If aphids threaten to become troublesome during the season, spray with one of:

(1) diazinon 50 W	3.00 kg/ha
(2) Thiodan, *or* Thionex 50 WP	3.25 kg/ha
(3) Zolone Flo	2.00 L/ha

These may be added to any of the sprays after bloom. Thorough coverage and a calm, warm day are necessary for good aphid control.

CHERRY YELLOWS VIRUS: Where a problem, Gibberellic acid (ACTIVOL GA) has been shown to increase fruit spur development. Use at the rate of 10 ppm (10 ACTIVOL GA tablets per 1000 L of water). Use 9 L of spray per tree. Higher rates may be required for old or less vigorous trees. AGRAL 90 at the rate of 113 mL per 450 L of water is suggested as a spreader sticker. Apply the spray during the period 7 to 21 days after petal fall. Gibberellic acid must be applied every year to improve bud development and later shoot growth. Follow manufacturer's directions

ETHREL: Ethrel is registered for commercial use as a chemical ripening and loosening aid. When applied according to manufacturer's directions the material tends to promote uniform maturity and loosens the fruit for easier mechanical harvest. Follow the manufacturer's **precautions and directions** for best results.

Growers are particularly cautioned against the use of Ethrel on trees that have experienced severe stress such as drought, disease or winter injury. Ethrel applied to such trees frequently causes severe gummosis.

Approximate Hours of Continuous Leaf Wetness Necessary to Produce Cherry Leaf Spot Infection[a]

	Degree of Infection		
Average Temp (°C)	**Light (hours)[b]**	**Moderate (hours)[b]**	**Heavy (hours)[b]**
10	18	27	36
13	11	19	26
16	6	14	20
19	5	12	19
21	6	14	22
23	10	20	31

(a) *Determined by S. Eisensmith and A. Jones, Michigan State University.*
(b) *Hours of wetness from the beginning of a rain. Assumes significant level of inoculum present.*

CURRANTS AND GOOSEBERRIES

For dilute spraying use 2000 L per hectare.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER 1000 LITRES	AMOUNT PER HECTARE	COMMENTS
BEFORE BUDS BREAK	Scale insects	superior oil	20 L	40 L	
JUST BEFORE BLOSSOMS OPEN	Leafspot	(1) ferbam WDG	1.00 kg	2.00 kg	Use ferbam on currants only.
	Powdery mildew	sulphur 92 WP	13.5 kg	27.0 kg	Gooseberries only. Do not use on "sulphur-shy" American varieties.
	Currant Sawfly Blister Aphid	(1) diazinon 50 WP or diazinon 500 EC (2) malathion 25 WP	1.00 kg 1.00 L 2.50 kg	2.00 kg 2.00 L 5.00 kg	Do not apply diazinon after bloom. Diazinon is highly toxic to honeybees. See page 9 for ways to reduce bee poisoning. Malathion is not registered for sawfly control.
DO NOT SPRAY CLOSER TO HARVEST THAN THE NUMBER OF DAYS GIVEN IN TABLE 22, page 89.					
POSTBLOOM as soon as bloom is complete	Leafspot	**Add one of fungicides listed above.**			
	Powdery mildew	**Same as for mildew above.**			Repeat weekly if warm and humid conditions persist.
	Currant Fruit Fly (maggot)	malathion 25 WP	2.50 kg	5.00 kg	Where this pest has been a problem, a second application is required in 10 days. For best results apply when the temperature is above 20°C.
10 DAYS AFTER POSTBLOOM SPRAY	Leafspot	**Same as for leafspot above.**			Do not use ferbam within 14 days of harvest. Spray red and white currants immediately after fruit is picked.
	Currant Fruit Fly (maggot)	malathion 25 WP	2.50 kg	5.00 kg	For best results, apply when temperature is above 20°C.
POSTHARVEST	Leafspot	**Same as for leafspot above.**			
	Aphids, Mites and Leafhoppers	malathion 25 WP	3.75 kg	7.50 kg	

POLLINATION: Currants and gooseberries are self-fertile, but insects assist in pollen transfer. Honeybees have been shown to increase crop yield. See page 8 for ways to reduce bee poisoning and also OMAF Publication 71, "Honey Bees and Pesticides", and Publication 72, "Pollination: Crops and Bees".

GRAPES

See chart "Relative Disease Susceptibility" at the end of the Grape calendar, page 17.

Read the label and follow all safety precautions. For dilute spraying refer to page 17, "GUIDE FOR SPRAYING TREE FRUITS"

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	COMMENTS
PHOMOPSIS SPRAYS	**See note A, page 40, for effectiveness of fungicides for control of grape diseases.**			
	Phomopsis cane and leaf spot	(1) captan 50 WP	3.25 kg	Spray varieties where phomopsis is a problem, when new shoots are 1.25 to 5 cm long, and again when 10 to 15 cm long. Apply at least 1700 L of spray per hectare.
		or captan 80 WP	2.00 kg	
		(2) Folpan 50 WP (Phaltan)	3.25 kg	
PREBLOOM	Berry moth	(1) [2]Guthion 50 WP	1.10 kg	Spray shortly before bloom where berry moth has been a problem. Consult local agriphone for best timing.
		or [2]Guthion 240 SC	2.00 L	
		or [2]APM 50 W	1.10 kg	
		or Guthion Solupak 50 WP	1.10 kg	Apply at least 1700 L/ha (dilute rate).
		(2) Sevin 50 WP	3.25 kg	
		(3) Imidan 50 WP	2.00 kg	**WARNING:** Under slow drying conditions or at temperatures above 24°C, any spray material or combinations are likely to cause some degree of injury, especially to the variety Foch.
		(4) diazinon 50 WP	1.75 kg	
		*(5) Cymbush 12.5 WP	480 g	
		*(6) Pounce 384 EC	360 mL	
	Downy mildew (see note A at end of Grape Calendar.)	(1) Folpan 50 WP (Phaltan)	3.25 kg	Spray Buffalo, Fredonia, President, Van Buren, French Hybrid and vinifera varieties. If bloom is delayed or if wet weather is expected, repeat the application. Check combinations for compatibility. See table 22, page 89.
		(2) captan 50 WP	3.25 kg	
		or captan 80 WP	2.00 kg	
		(3) Polyram 80 DF	3.25 kg	
		(4) Dikar WP	3.25 kg	
		(5) Dithane M-45 80 WP	3.25 kg	
		or Manzate 200 80 WP	3.25 kg	
	Black Rot	(1) ferbam 76 WDG	3.25 kg	Susceptible varieties include Catawba, Concord, Agawam, Niagara, Pinot Chardonnay, Ventura, Dutchess. Refer to disease susceptibility chart for susceptibility of cultivars.
		(2) Benlate 50 WP	850 g	
	DO NOT APPLY INSECTICIDES WHEN GRAPES ARE IN BLOOM. See note on pollination, page 8.			
POST BLOOM	Leafhoppers	(1) [2]Guthion 50 WP	1.50 kg	Monitor vineyard and consult agriphone for past activity in area.
		or [2]Guthion 240 SC	2.75 L	
		or [2]APM 50 W	1.50 kg	
		or Guthion Solupak 50 WP	1.50 kg	
		(2) Sevin 50 WP	4.50 kg	
		(3) Imidan 50 WP	2.75 kg	
		(4) diazinon 50 WP	2.25 kg	
		*(5) Cymbush 12.5 WP	480 g	
		*(6) Pounce 384 EC	360 mL	
	Grape Phylloxera (leaf form)	Add: Thiodan, *or* Thionex 50 WP	2.25 kg	Only French hybrid and vinifera varieties are susceptible to this pest. Thiodan, Thionex may cause injury to Concord, Cascade, Baco, Seibel 8357 and Seibel 7053 (Chancellor).
	Downy Mildew Black Rot	Add one of		Spray all varieties for mildew at this time. Repeat spray for black rot where it is a problem.
		(1) Folpan 50 WP (Phaltan)	4.25 kg	
		(2) captan 50 WP	4.25 kg	
		or captan 80 WP	2.25 kg	
		(3) Polyram 80 DF	4.25 kg	
		(4) Dikar WP	4.25 kg	Dikar, Dithane M-45 and Manzate 200 are not registered for black rot control.
		(5) Dithane M-45 80 WP	4.25 kg	
		or Manzate 200 80 WP	4.25 kg	

	Powdery Mildew	(1) sulphur 92 WP	9.0 kg	See note B, page 40.
		or Kumulus DF 80 WP	12.6 kg	A program for powdery mildew is most effective when started
		(2) Karathane WD 18.25 WP	1.1 kg	at this time. DO NOT use sulphur or Kumulus DF on Concord,
		(3) Dikar WP	4.5 kg	Foch, Van Buren or De Chaunac.
		(4) Benlate 50 WP	1.1 kg	See warning under **PREBLOOM.**
	Botrytis bunch rot			**See note C, page 40.**
FIRST COVER 12 days after **POST BLOOM**	Berry moth	(1) [2]Guthion 50 WP	1.75 kg	Where berry moth is a regular problem, apply one of these
		or [2]Guthion 240 SC	3.10 L	materials at a rate of 2800 L/ha (dilute). Consult local agriphone
		or [2]APM 50 W	1.75 kg	for timing and if additional sprays may be needed to control
		or Guthion Solupak 50 WP	1.75 kg	this second generation.
		(2) Sevin 50 WP	5.50 kg	
		(3) Imidan 50 WP	3.25 kg	
		(4) diazinon 50 WP	2.75 kg	
		*(5) Cymbush 12.5 WP	480 g	Thorough spraying reduces chances of a late second brood.
		*(6) Pounce 384 EC	360 mL	
	Phylloxera (leaf form)			Repeat as in **POSTBLOOM** spray.
	Powdery Mildew	(1) Dikar WP	5.5 kg	DO NOT use sulphur of Kumulus DF on Concord, Foch,
		(2) Karathane WD 18.25 WP	1.5 kg	Van Buren or De Chaunac.
		(3) sulphur 92 WP	11.0 kg	See note B, page 40.
		or Kumulus DF 80 WP	12.6 kg	
		(4) Benlate 50 WP	1.5 kg	
		(5) Folpan 50 WP (Phaltan)	5.5 kg	
	Downy Mildew Black Rot	(1) Dikar WP	5.50 kg	Repeat spray for black rot where it is a problem.
		(2) Folpan 50 WP (Phaltan)	5.50 kg	
		(3) captan 50 WP	5.50 kg	Dikar, Dithane M-45 and Manzate 200 are not registered for
		or captan 80 WP	3.25 kg	black rot control.
		(4) Polyram 80 DF	5.50 kg	
		(5) Dithane M-45 80 WP	5.50 kg	
		or Manzate 200 80 WP	5.50 kg	
SECOND COVER 10 days after **FIRST COVER**	Powdery Mildew	(1) sulphur 92 WP	11.0 kg	DO NOT use sulphur or Kumulus DF on Concord, Foch,
		or Kumulus DF 80 WP	12.6 kg	De Chaunac or Van Buren varieties. For effective control of
		(2) Karathane WD 18.25 WP	1.5 kg	powdery mildew apply in at least 2800 L water per hectare
		(3) Dikar WP	5.5 kg	(dilute rate). Do not apply closer to harvest than the number
		(4) Benlate 50 WP	1.5 kg	of days given in Table 22, page 89.
	Black Rot	(1) ferbam 76 WDG	4.50 kg	Repeat spray for black rot where it is a problem. For effective
		(2) Benlate 50 WP	1.25 kg	control, apply in at least 2800 L water per hectare (dilute rate).

[2]Minimum period before reentry is 48 hours.

****Repeated applications of synthetic pyrethroids are discouraged. See "Pest Resistance", page 18.***

GRAPES (Continued)

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	COMMENTS
	Botrytis bunch rot	Rovral 50 WP	1.5 kg	To minimize the development of resistance, it is strongly suggested that only two applications of Rovral be made per season, these being in late July and mid-August as bunches are closing. See note C at the end of the Grape calendar, page 40.
FURTHER COVER SPRAYS	Powdery Mildew	Use one of the materials listed under **SECOND COVER** and check for interval to harvest.		Varieties such as Concord, Niagara, Elvira and Fredonia are not as susceptible to this disease and extra sprays are usually not needed. Susceptible varieties such as Agawam, Delaware, French hybrid, New York Muscat, Seneca, and vinifera cultivars often require extra sprays at 10-DAY intervals.
	Berry moth about August 20.	Use one of the materials listed under **FIRST COVER** and check the interval to harvest.		A spray may be needed on late varieties to control the brood which emerges in late August. Border sprays may be very effective.
	Botrytis bunch rot	Rovral 50 WP	1.5 kg	See note C at the end of the Grape calendar, page 40. See "Pest Resistance", page 10.
POST HARVEST	Powdery Mildew	(1) sulphur 92 WP or Kumulus DF 80 WP (2) Dikar WP (3) Benlate 50 WP	11.00 kg 12.60 kg 5.50 kg 1.25 kg	Infection by powdery mildew after harvest may leave canes more susceptible to winter injury. Cultivars sensitive to mildew should receive 1 or 2 sprays after harvest to protect the wood. Some premature defoliation may be observed when using sulphur or Kumulus, but this is not likely to affect vine vigour.

RELATIVE DISEASE SUSCEPTIBILITIES

This chart provides a relative rating of cultivar susceptibility under average conditions. Under adverse weather conditions, i.e. extended cool weather, any given cultivar may be more seriously affected.

Blank = relative susceptibility is unknown
\+ = slight susceptibility
++ = moderate susceptibility
+++ = highly susceptible

1 = sulphur sensitive
2 = Dikar + Zolone combination may be phytotoxic
3 = Dikar sensitive
4 = Karathane sensitive
5 = Thiodan sensitive

RATING OF SUSCEPTIBILITY TO DISEASES

Cultivar	Type*	Eutypa Dead Arm	Phomopsis Cane Blight	Black** Rot	Downy Mildew	Powdery Mildew	Botrytis Bunch Rot	Phytotoxicity*** Chemical Sensitivty
Agawam	L	+	++	+++	+++	++		4
Aurore	FH	+	++	+	+	+++	++	
Auxerrois	V		++		+	+++	+++	
Baco Noir	FH		++	+		++	+	4,5
Cabernet Franc	V				+	+++	+	
Cab. Sauvignon	V				+	+++	+	
Canada Muscat	L			+	++	+++		
Canadice	L					+	++	
Catawba	L	+	+	+++	++	++		
Chambourcin	FH		+			++	+	1,4,5

Chancellor	FH		+	+	+++	+++	++	
Chardonnay	V	+		+++	++	+++	++	3,4
Chelois	FH	+++	++	++	+	+++	++	3,4
Concord	L	+	++	++	++	++		1,4,5
Couderc Muscat	FH			++		+++	+	
De Chaunac	FH	+	+++	+	+	++	+	1,4
Delaware	L	++		++	+++	++	+	4
Dutchess	L	++	++	+++	++	++	+	
Elvira	L	+++	+++	++	+	++	++	
Festivee	AH				+	+++	++	
Foch	FH	++	++	+		++	+	1,2,3,4
Fredonia	L	+	++	++	+++	++	+	
Gamay	V	+	+	+	++	+++	++	
Gewurztraminer	V	++			+	+++	+++	
Himrod	AH		+			++		
I.S.23-416	FH		+			++		
Kerner	V				+++	++	+	
Le Commandant	FH	+		++		++	+	2
Merlot	V				+	+++	+	
N.Y. Muscat	L	+		+	+	++	+	
Niagara	L	++	++	+++	+++	++	+	
Pinot Noir	V				+	+++	+++	
Riesling	V	+	+	+++	++	+++	+++	
Rosette	FH		++	++	+	+++	+	4
Scheurebe	V				+	+++	+	
Seyval Blanc	FH		++	++	++	+++	+++	
Sov. Coronation	L		+			+		
S.V. 172	FH					++	++	
S.V. 23-512	FH		+			++		
V. 50201	FH	+++	++		+++	++	+	
Van Buren	L	+			+++	++		1
Veeblanc	L			++		++	++	
Veeport	L	+	+	+		+++		
Ventura	L	++	++	++		++		
Verdelet	FH	+				++		
Vidal 256	FH		+	+		++	+	4
Vincent	L	+	+			+++	+	
Villard Noir	FH		+			++		3,5
Vivant	L	+	+	++	++	++	+	

* = Species type L = lubrusca, AH = American hybrids, FH = French hybrids, V = vinifera.
Note that all vinifera varieties not included in this chart should be considered powdery mildew susceptible.

** = Black rot is more serious adjacent to bush or similar areas with poor air drainage.

*** = These notes are based on grower experiences and could vary under stress conditions.

Notes:

A. EFFECTIVENESS OF FUNGICIDES FOR CONTROL OF GRAPE DISEASES:

0 = ineffective + = slightly effective ++ = moderately effective +++ = very effective

Fungicide	Phomopsis cane and leaf spot	Black rot	Downy Mildew	Powdery Mildew	Botrytis bunch rot
Folpan, (Phaltan) (1 day)	+++	++	+++	++	+
captan (7 days)	+++	++	+++	0	+
Dikar (30 days)	+	+++	+++	+++	0
Dithane M-45 (30 days)	+	+++	+++	0	0
Manzate 200 (30 days)	+	+++	+++	0	0
ferbam (7 days)	+	+++	++	0	0
sulphur (21 days wine, 1 day table)	0	0	0	+++	0
Kumulus DF (21 days wine, 1 day table)	0	0	0	+++	0
Benlate (7 days)	+	++	0	+++	0
Karathane (30 days)	0	0	0	+++	0
Rovral (7 days)	0	0	0	+	+++
copper-lime (30 days wine)	+	++	++	++	0
Polyram (45 days)	?	+++	+++	0	0

B. FIXED COPPER: Fixed copper 50-53% WP 750 g and hydrated lime 3 kg will help control powdery mildew, when used for control of downy mildew on the less susceptible varieties, but is not sufficiently effective on varieties which are very susceptible to powdery mildew. (Harvest interval on wine grapes is 30 days.) The fixed copper and lime mixture will not control powdery mildew but is involved in hardening of the plant tissue, thereby making it less susceptible. Copper cannot be used on French hybrid or vinifera varieties, and is NOT compatible with any of the presently recommended insecticides. It may be used, however when no insecticides are being used.

C. BUNCH ROT: Many of the vinifera and vinifera hybrid cultivars with tight bunches are susceptible to Botrytis bunch rot, e.g. Gamay, Riesling, Chardonnay, Chancellor, Aurore and Seyval Blanc. Rovral is the only fungicide currently registered for control of bunch rot, but already Rovral-resistant *Botrytis cinerea* has been found in several Ontario vineyards where Rovral has been used.

Benlate cannot be recommended because of the widespread distribution of Benlate-resistant botrytis in vineyards. The only alternatives are captan and Folpan which have moderate to good activity, but their use against bunch rot is not currently registered. To minimize the development of resistance to Rovral it is strongly proposed that only two applications of Rovral be made per season, and these should be made in late July and mid-August as bunches are closing. On late harvested cultivars, a third application in early September may protect ripening berries from direct infection during wet weather. To obtain adequate spray coverage during mid and late summer use at least 900 L of spray per hectare. The protection of clusters from Bloom to mid-July may be obtained by the use of captan or Folpan at the rates recommended for the control of downy mildew given under First Cover.

POLLINATION: All commercial varieties grown in Ontario are self-fruitful and pollinated by wind and it is not considered necessary to provide honeybees for pollination.

PEACHES and NECTARINES

For dilute spraying refer to page 17, "GUIDE FOR SPRAYING FRUIT TREES".

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	COMMENTS
DORMANT In March or early April before buds swell	Leaf-curl only (Spring leaf-curl spray is not needed where a spray was applied last fall.)	(1) ferbam 76 WDG (2) DNOC liquid (Elgetol)	6.75 kg 16.75 L	Delay may result in poor control of leaf curl. Oil may be added to the ferbam spray to control scale insects. Dilute ferbam in tank, then add oil. See note A at end of PEACH calendar, page 43.
	San Jose Scale	Add one of: (1) superior oil (2) Ethion superior oil	 60 L 60 L	Apply oil routinely every third year. If scale is a serious or continuing problem, apply oil for at least two consecutive years.
PREBLOOM Half-inch Green to First Pink	European Red Mite	(1) superior oil (2) Ethion superior oil (3) superior oil concentrate	60 L 60 L 15 L	Preferred time to use oil for red mite control when over-wintering populations are high. Red mite populations are more likely to be high when pyrethroid sprays were used the previous year for Tarnished Plantbug control.
PINK THROUGH BLOOM	Blossom blight stage of brown rot	(1) Phygon-XL 50 WP (2) captan 50 WP or captan 80 WP (3) Funginex 190 EC (4) Rovral 50 WP (5) sulphur 92 WP	1.50 kg 6.00 kg 3.75 kg 2.50 L 1.50 kg 20.25 kg	Spray when first blossoms are opening (late pink). Repeat every 4 to 5 days if weather is wet. Funginex has good eradicant activity. See note on Funginex, page 11. Do not use Rovral or Funginex more than 2 times per season, and never in consecutive sprays. Use of sulphur may encourage mite build-up.
PETAL FALL AND SHUCK SPRAY	Mealy Bug	[3]parathion 15 WP	5.00 kg	Check for mealy bug when shucks start to split and if necessary apply spray at 50% shuck split and repeat in 10 to 12 days. See First Oriental Fruit Moth Spray.
	Tarnished Plant Bug	(1) [2]Guthion 50 WP or [2]APM 50 W or [2]Guthion Solupak 50 WP *(2) Ambush 500 EC *(3) Cymbush 12.5 WP	2.0 kg 2.0 kg 2.0 kg 400 mL 560 g	This spray may be necessary in southwestern counties where early season plant bug injury known as 'cat facing' has been a problem. Early springs accompanied by warm temperatures (above 16°C) promotes plant bug activity. If wet conditions prevail, a fungicide should be included for brown rot control.
SEE NOTE C, PAGE 00, FOR CULTURAL CONTROL METHODS OF PLANT BUGS.				
FIRST ORIENTAL FRUIT MOTH SPRAY	Oriental Fruit Moth	(1) Imidan 50 WP (2) [2]Guthion 50 WP or [2]APM 50 W or [2]Guthion Solupak 50 WP (3) [3]parathion 15 WP (4) Sevin 50 WP *(5) Ambush 500 EC *(6) Decis 2.5 EC *(7) Pounce 384 EC	3.75 kg 2.00 kg 2.00 kg 2.00 kg 5.00 kg 6.00 kg 200 mL 400 mL 275 mL	Consult Agriphone for timing. Where mealy bug is a problem, use parathion. See Petal Fall spray. Thorough coverage is essential to control mealy bug. Repeated applications of Ambush, Pounce or Decis are discouraged. See "Pest Resistance", page 10.

[2]Minimum period before reentry is 48 hours.

[3]Minimum period before reentry is 7 days.

****Repeated applications of synthetic pyrethroids are discouraged. See "Pest Resistance", page 10.***

PEACHES and NECTARINES (Continued)

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	COMMENTS
	Brown Rot	(1) captan 50 WP	6.00 kg	Under rainy conditions, repeat the fungicide in 10 days.
		or captan 80 WP	3.75 kg	
		(2) sulphur 92 WP	20.25 kg	
	European Red Mite	If a dormant oil was not applied use:		Check leaves and apply this spray if 10-15 mites/leaf are present. **WARNING:** Repeated use of Kelthane has lead to red mite resistance.
		Kelthane AP-35	4.5 kg	
		or Kelthane 187.5 EC	8.5 L	
	Lesser peach tree borer Peach tree borer			See note B at end of PEACH calendar.
SPECIAL SPRAYS	Obliquebanded leafroller	(1) [2]Guthion 50 WP	2.00 kg	Where this pest has been a problem in past years, consult Agriphone for timing.
		or [2]APM 50 W	2.00 kg	
		or [2]Guthion Solupak 50 WP	2.00 kg	
		(2) Imidan 50 WP	3.75 kg	
	Tarnished Plant Bug	(1) [2]APM 50 W	2.0 kg	Where this pest has been a problem in past years, consult Pest Management Advisor or Horticultural Crop Advisor for proper timing. General timing is mid-June. Where plant bug pressure is high, sprays may have to be repeated in 5-7 days.
		or [2]Guthion 50 WP	2.0 kg	
		or [2]Guthion Solupak 50 WP	2.0 kg	
		*(2) Ambush 500 EC	400 mL	
		(3) Thiodan, *or* Thionex 50 WP	4.5 kg	
		*(4) Cymbush 12.5 WP	560 g	
	SEE NOTE C, PAGE 44, FOR CULTURAL CONTROL METHODS OF PLANT BUGS.			
SECOND ORIENTAL FRUIT MOTH SPRAY	Oriental Fruit Moth	Use same insecticides as in **FIRST ORIENTAL FRUIT MOTH SPRAY**		Spray all varieties. Consult Agriphone for timing. Repeated applications of Ambush, Decis or Pounce are discouraged. See "Pest Resistance", page 10.
	Brown Rot (early varieties only) Earlired through Sunhaven	(1) captan 50 WP	6.00 kg	Do not use Rovral more than 2 times per season and never in consecutive sprays. Use of sulphur may induce mite problems.
		or captan 80 WP	3.75 kg	
		(2) Rovral 50 WP	1.50 kg	
		(3) sulphur 92 WP	20.25 kg	
SPECIAL SPRAYS	European Red Mite	(1) Omite 30 W	5.5 kg	Consult Agriphone for exact timing. This spray usually can be applied around the second Oriental Fruit Moth Spray (early July). On cultivars Harbrite and later, examine for mites again three weeks before harvest. More than one mite per leaf (average) in mid-July can result in a mite infestation in August. If two miticides are required during July and August on late maturing cultivars, be sure to alternate between materials. **DO NOT APPLY THESE MITICIDES CLOSER TO HARVEST THAN IN TABLE 22, PAGE 89.**
		(2) Kelthane AP-35	4.5 kg	
		or Kelthane 187.5 EC	8.5 L	
THIRD ORIENTAL FRUIT MOTH SPRAY (LATE VARIETIES ONLY)	Oriental Fruit Moth	(1) Imidan 50 WP	3.75 kg	Usually for all varieties from Harbrite-Vivid season and later (about August 4). Consult Agriphone for timing. Repeated applications of Ambush, Decis or Pounce are discouraged. See "Pest Resistance", page 10.
		(2) Sevin 50 WP	6.00 kg	
		*(3) Ambush 500 EC	200 mL	
		*(4) Decis 2.5 EC	400 mL	
		*(5) Pounce 384 EC	275 mL	

	Brown Rot	(1) captan 50 WP or captan 80 WP (2) Rovral 50 WP (3) sulphur 92 WP	6.00 kg 3.75 kg 1.50 kg 20.25 kg	To be included on all varieties.
PREPICK SPRAY	Oriental Fruit Moth	(1) Imidan 50 WP (2) Sevin 50 WP *(3) Ambush 500 EC *(4) Decis 2.5 EC *(5) Pounce 384 EC	3.75 kg 6.00 kg 200 mL 400 mL 275 mL	Spray each variety 7-10 days before first harvest when first colour shows.
	Brown Rot	(1) captan 50 WP or captan 80 WP (2) Rovral 50 WP (3) sulphur 92 WP	6.00 kg 3.75 kg 1.50 kg 20.25 kg	Apply with OFM spray 7-10 days before harvest. Do not use Rovral more than 2 times per season, and never in consecutive sprays. Use of sulphur may induce mite problems.
	Rhizopus Rot	Botran 75 WP	3.25 kg	
SPECIAL SPRAY	Brown Rot	(1) Rovral 50 WP (2) sulphur 92 WP	1.50 kg 20.25 kg	THIS SPRAY IS ONLY NECESSARY UNDER RAINY AND HUMID CONDITIONS JUST PRIOR TO HARVEST (WITHIN THREE DAYS OF PICKING). This is the preferred time to use Rovral. Do not use Rovral more than 2 times per season and never in consecutive sprays. Use of sulphur may induce mite problems.
POSTHARVEST TREATMENT	Rhizopus Rot (Black whiskers)	(1) Botran 75 WP (2) Peach, Nectarine and Plum Lustre 274	875 g/500 L water	Dip harvested peaches in a suspension. Keep suspension agitated while dipping. Read the label. Apply 1 L wax on 3500 kg of fruit.
FALL SPRAY Preferred time to spray for leaf-curl	Leaf-curl	(1) ferbam 76 WDG (2) DNOC liquid (Elgetol)	6.75 kg 16.75 L	Any time after leaves are off in fall or winter when temperature in shade is above freezing, and conditions favour rapid drying.

[2]Minimum period before reentry is 48 hours.
**Repeated applications of synthetic pyrethroids are discouraged.*
See "Pest Resistance", page 10.

Notes:

A. OIL AND FERBAM: Ferbam should be added to water in a partially filled tank before oil is added. With agitator running, sift ferbam slowly into water, or, preferably, slurry in with water in a pail and then add to tank. Add oil last, as remainder of water is being added. To keep mixture uniform, do not stop engine until contents of tank are sprayed out. If oil is noticed floating on top of water, remix by turning a spray gun into tank. Injury may result to last few trees at end of tank if emulsion breaks.

B. LESSER PEACH TREE BORER AND PEACH TREE BORER: Make three applications, the first 5 to 10 days after the **FIRST ORIENTAL FRUIT MOTH** spray, the second three weeks later, and the third three weeks after the second. Apply the sprays with a gun

and cover the trunk and scaffold limbs thoroughly. In the first spray, use Thiodan, *or* Thionex 50 WP 1.5 kg per 1000 L or Thiodan 4 EC 1.75 L per 1000 L or Endosulfan 400 EC 1.75 L per 1000 L. In the second spray, use Thiodan *or* Thionex as above on all varieties except those in the Earlired, Harrow Diamond and Garnet Beauty season. On such varieties use Sevin 50 WP 2.0 kg per 1000 L. In the third spray, use Thiodan or Thionex as above on all varieties except those in the Sunhaven, Redhaven, Veecling and Vivid season. On such varieties use Sevin as in the second spray.

C. PLANT BUGS: There are two sources of plant bug: (1) residents which overwinter within the orchard and (2) migrants which overwinter on hosts outside the orchard and disperse into the orchard during the growing season. In addition to the insecticide sprays listed in the calendar the following cultural methods are suggested: (1) to minimize the size of the resident populations and (2) to provide an alternate food source for the summer generations of migrant plant bugs.

I Remove any large oak trees adjacent to peach blocks to avoid oak bug injury. White and red oaks are more important than the Burr type.

II Apply a contact herbicide in the herbicide strip areas, e.g. paraquat, to early season hosts of plant bug which are mainly mint, creeping charlie and annual and perennial chickweed. In most years herbicide applications should be applied by about April 20th in Southwestern Ontario and May 1st in the Niagara Peninsula.

III Apply a second herbicide such as a contact plus residual to the herbicide strip area in the latter part of May in order to provide season long control of weeds in your orchard.

IV Where clean cultivation is practised, this should begin as early as possible and continue up to about May 15th in Southwestern Ontario and June 1st in the Niagara Peninsula.

Early cultivation will reduce the numbers of resident plant bugs. Stopping cultivation during the June period is to encourage the establishment of weeds such as pigweed and lambsquarters which will provide and alternate food source for 1st generation plant bug, and thus discourage feeding on peach fruit.

V Where sod culture is adopted, frequent mowing, e.g. every 2 weeks, should be practised. Encouragement of weed free sod should be done with fertilizer and herbicide use as necessary. Creeping red fescue or other grasses are the preferred species for sod. Clover should be avoided.

VI Where the use of cover crops in cultivated peach orchards is practised to lower nitrogen levels and check tree growth, the preparation and sowing of the cover crop should be delayed until July 10th and when the major danger of extensive plant bug injury is over.

For more information on the biology of plant bugs and the nature of the injury consult OMAF Factsheet, Pest Management Program for Peach Series – Tarnished Plant Bug, Agdex 212/634.

D. PEACH CANKER. The following practices aid greatly in the prevention of peach canker: When pruning, growers should avoid cutting into the collar area of the branch or limb where it meets scaffolding or the trunk of the tree. Evidence from the United States and Ontario suggests that when the collar area is injured or cut in any way, the healing process is delayed or impaired since wound periderm tissues are located primarily in the collar region.

At Planting Time and First Year:

1. Plant good nursery stock. Use Thiodan dip for borer control. See Guidelines for Protecting Young Non Bearing Peach Plantings.
2. When pruning at planting time, remove all poor angles and weak side branches.
3. Treat all cuts immediately with a wound dressing.
4. Go over trees in mid-June and remove all dead wood and obviously poorly angled live branches.
5. Cut out cankers in June and treat with a wound dressing.
6. Apply sprays for fruit moth, peach tree and lesser borer.
7. Sow a cover crop (early July).
8. Protect from rabbits and mice.

Second Year and Following Years:

1. Apply nitrogen fertilizers early (March, April) to bearing trees. Avoid late applications of manure.
2. Prune as late in the spring as possible. Prune two and three year old trees after bloom.
3. Do not prune immediately preceding rains.
4. Remove all dead wood and poorly angled branches.
5. Treat pruning cuts in the main scaffold areas of the tree with a wound dressing.
6. Go over scaffolds in June and remove dead wood and poorly placed new growth.
7. In June cut out any cankers on scaffolds and treat with a wound dressing.
8. Apply sprays for fruit moth, peach tree borers, plant bugs and brown rot.
9. Sow a cover crop (early June).
10. Protect from rabbits and mice.

Use the following wound dressing: Thiram-latex paint as suggested for southwest injury (see page 78). It has been shown to be an effective wound dressing for peach trees at the Research Station in Harrow. (Use on a trial basis only). Dissolve 400 g thiram 75 WP in 2 L of water. Add slowly to 4 L of good exterior white latex house paint and mix well. Also see OMAF Factsheet, Peach Canker, Agdex 212/634.

POLLINATION: All commercial varieties grown in Ontario are self-fruitful and may be planted in solid blocks. Bees readily work peach blossoms and frequently cause an over-set, which may necessitate thinning. For this reason, the placement of hives in peach orchards is not usually recommended. See OMAF Publication 72, "Pollination: Crops and Bees".

NEMATODE CONTROL: see page 79.

GUIDELINES FOR PROTECTING YOUNG NON-BEARING PEACH PLANTINGS

The following is designed to offer limited protection when needed for newly planted trees.
It is not intended to be used for protection of bearing orchards. Rates are for dilute spraying.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER 1000 L	COMMENTS
PREPLANT	Nematodes			See page 79 for notes. Peaches are very susceptible to nematodes, especially Siberian rootstock.
	Lesser Peach Tree Borer Peach Tree Borer	(1) Thiodan 4 EC *or* Thiodan 50 WP *or* Thionex 50 WP *or* Endosulfan 400 EC	1.25 L/100 L 1.25 kg/100 L 1.25 kg/100 L 1.25 L/100 L	If trees were not treated at the nursery, dip the roots and crown. Thiodan, Thionex wettable powder preparation must be stirred constantly to prevent settling out. The dip provides control for peach tree borer in the first year. SPECIAL PRECAUTIONS: Use rubber gloves to avoid exposing skin to insecticide. Dispose of excess material with extreme care. Thiodan, Thionex is extremely toxic to fish and wildlife.
FIRST ORIENTAL FRUIT MOTH SPRAY (OFM) and FIRST BORER SPRAY	Oriental Fruit Moth Lesser Peach Tree Borer – see note (e) below	(1) Imidan 50 WP (2) [2]Guthion 50 WP *or* [2]APM 50 W or [2]Guthion Solupak 50 WP (3) Thiodan 4 EC *or* Thiodan 50 WP *or* Thionex 50 WP *or* Endosulfan 400 EC	1.25 kg 0.67 kg 0.67 kg 0.67 kg 1.75 L 1.50 kg 1.50 kg 1.75 L	Consult Agriphone for timing. For borer control, aim a nozzle toward the trunk. See note (e) below.
SECOND ORIENTAL FRUIT MOTH SPRAY and SECOND BORER SPRAY	Oriental Fruit Moth Lesser Peach Tree Borer – see note (e) below	(1) Imidan 50 WP (2) [2]Guthion 50 WP *or* [2]APM 50 W or [2]Guthion Solupak 50 WP (3) Thiodan 4 EC *or* Thiodan 50 WP *or* Thionex 50 WP *or* Endosulfan 400 EC	1.25 kg 0.67 kg 0.67 kg 0.67 kg 1.75 L 1.50 kg 1.50 kg 1.75 L	Consult Agriphone for timing. For borer control, aim a nozzle toward the trunk. See note (e) below.
THIRD ORIENTAL FRUIT MOTH SPRAY and THIRD BORER SPRAY	Oriental Fruit Moth Lesser Peach Tree Borer and Peach Tree Borer – see note (e) below	(1) Imidan 50 WP (2) [2]Guthion 50 WP *or* [2]APM 50 W or [2]Guthion Solupak 50 WP (3) Thiodan 4 EC *or* Thiodan 50 WP *or* Thionex 50 WP *or* Endosulfan 400 EC	1.25 kg 0.67 kg 0.67 kg 0.67 kg 1.75 L 1.50 kg 1.50 kg 1.75 L	Apply OFM spray only if trees are actively growing. Listen to Agriphone for timing. Aim a nozzle toward the trunk for borer control. Apply Thiodan, Thionex or Endosulfan only if you have peach tree borer activity. See note (e) below.

Notes:

(a) **Mites** are usually not a problem on non-bearing trees. Trees can tolerate about 30 mites per leaf.

(b) **Green Peach Aphid** may colonize and stunt new growth. Begin monitoring in mid to late May for this pest. Consult Horticultural Crop Advisor or Pest Management Advisor for control strategy.

(c) **Canker Surgery** and dead wood removal should take place in June or July when rapid growth and the healing of the tree can take place. Surgery should be conducted when there is a forecasted period of dry weather following. During surgery remove all diseased bark around the canker and about 3 to 5 centimetres of healthy tissue from around the sides and ends, respectively. The resulting wound when finished should have a smooth margin and be slightly rounded above and below to favour rapid wound closure. Surgery sites in June and July are thought to heal best if left uncovered without wound dressing. Some pruning paints actually seal in moisture thus providing an ideal environment for fungal infection.

(d) **Southwest Injury and Rodent Control:** The use of latex paint plus Thiram is strongly recommended. The whole trunk, plus the base of major scaffolds should be painted. See page 78 for details.

(e) **Borers** invade trunks from the ground level up and may complicate canker infections. The problem appears to be more severe in Southwestern Ontario. Injury may be reduced by trunk drenches of Thiodan 4 EC at 1.75 L per 1000 L of water, applied 5 to 10 days after each OFM spray in the second year. Insecticides for OFM will help control borer if trunk coverage is thorough.

[2]Minimum period before reentry is 48 hours.

PEARS

Read the label and follow all safety precautions. For dilute spraying, refer to page 17, "GUIDE FOR SPRAYING TREE FRUITS".

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	COMMENTS
DORMANT	Scale Insects Pear Psylla	Superior oil (60-70 vis.)	60 L	Apply full rate of oil in 2000-3000 L of water per hectare. 3000 L will give best results. Good coverage is essential. **DO NOT APPLY FULL RATE OF OIL MORE THAN ONCE PER SEASON.**
GREEN TIP	Scab	(1) Cyprex 65% WP or Equal 65% WP (2) captan 50% WP or captan 80% WP (3) Dikar WP (4) Benlate 50% WP plus Manzate 200 80% WP	3.25 kg 3.25 kg 6.00 kg 3.75 kg 6.75 kg 550 g 3.25 kg	It is important to start scab control early and repeat the spray if weather remains wet. **SEE NOTE C, PAGE 48, AT END OF PEAR CALENDAR.** Alternate Benlate-Manzate with full rates of captan, Dikar, Cyprex or Equal to avoid Benlate resistance.
	European Red Mite Pear Psylla	(1) superior oil (2) ethion superior oil (3) superior oil concentrate	60 L 60 L 15 L	Best applied at or near Green Tip for mites. Good coverage necessary. Superior oil concentrate is not effective for psylla control. **DO NOT APPLY FULL RATE OF OIL MORE THAN ONCE PER SEASON.**
PREBLOOM As blossoms show white at tips	Scab	Add one of the fungicides listed for scab control under GREEN TIP.		Repeat spray if weather remains wet.
	Rust Mite European Red Mite			Rust mite control should be applied at prebloom **or** petal fall. See note B at end of PEAR calendar. Alternate miticides.
		(1) Morestan 25% WP (2) Carzol 92 SP (3) Kelthane AP-35 or Kelthane 187.5 EC (4) ethion 25% WP	2.25 kg 1.10 kg 4.50 kg 8.50 L 6.75 kg	Morestan is also effective against pear psylla at 6 kg/ha rate. Morestan should not be used within 14 days of oil. Carzol is harsh on beneficial mite species and bees. Some resistant mites may be present where Kelthane has been used for four or more years and an alternative miticide is advisable.
	Pear Psylla			To avoid resistance problems, synthetic pyrethroids are not recommended at this time. Refer to comments at **FIRST COVER.** Morestan must not be used within 14 days of oil. Guthion and APM will also control green fruitworm.
		(1) Morestan 25% WP (2) [2]Guthion 50% WP or [2]APM 50% W (3) Thiodan, Thionex 50% WP	6.0 kg 2.1 kg 2.1 kg 5-6.75 kg	Check the label.
	Green Fruitworm	(1) [2]Guthion 50% WP or [2]APM 50% WP (2) Imidan 50% WP	2.10 kg 2.10 kg 3.75 kg	
	Plant Bugs	Thiodan, Thionex 50% WP	3.25-4.5 kg	Check the label. Thiodan helps to control psylla.

DO NOT APPLY INSECTICIDES WHEN PEAR TREES ARE IN BLOOM. See note on Pollination, page 8, and also OMAF Publication 71, "Honey Bees and Pesticides".

BLOOM	Fire Blight	Agri-Mycin 17	600 g/1000 L	High-volume spraying preferable. Use alone for best results. See page 15.
PETAL FALL	Pear Psylla Plum Curculio	(1) [2]Guthion 50% WP or [2]APM 50% W	2.10 kg 2.10 kg	
		(2) Thiodan, Thionex 50% WP	5-6.75 kg	Check the label. Thiodan is not registered for curculio control.
		(3) Imidan 50% WP	3.75 kg	
	Rust Mite European Red Mite	Add one of the miticides listed in **PREBLOOM** except Morestan.		A single miticide applied at prebloom or petal fall is necessary for good mite control. Rust mite must be controlled by this time to avoid russeted fruit at harvest. Alternate Miticides.
	Leaf Spots Scab	Add one of the fungicides listed for Scab at **GREEN TIP.**		If weather is wet extra sprays will be needed for scab control before **FIRST COVER.**
	Mealybug	See note A at end of PEAR calendar, page 48.		
FIRST COVER About June 25	Pear Psylla	*(1) Decis 2.5 EC	700 mL	Preferred time for psylla control with synthetic pyrethroids (materials 1-4). Use of synthetic pyrethroids is only recommended once per year and only when there are high populations of psylla. Pyrethroids are more effective when temperatures are cool.
		*(2) Belmark 300 EC	450 mL	
		*(3) Ripcord 400 EC	250 mL	
		or Cymbush 12.5% WP	560 g	
		*(4) Ambush 500 EC	400 mL	
		or Pounce 384 EC	520 mL	
		(5) Thiodan, Thionex 50% WP	5-6.75 kg	Check the label.
		(6) [2]Guthion 50% WP	2.10 kg	Where plum curculio is a problem use one of the materials recommended at PETAL FALL.
		or [2]APM 50% W	2.10 kg	
	Blister Mite	(1) Sevin 50% WP	6.00 kg	
		(2) Thiodan, Thionex 50% WP	3.25-4.5 kg	Check the label.
	Scab	Add one of the fungicides listed under **GREEN TIP.** Reduce rate of Cyprex or Equal to 2.25 kg/ha in cover sprays.		
SPECIAL SPRAY	Obliquebanded leafroller	(1) [2]Guthion 50% WP	2.10 kg	Where pest has been a problem, consult Horticultural Crop Advisor for proper timing. A second spray may be necessary in mid-August. Belmark should not be used within 60 days of harvest.
		or [2]APM 50% W	2.10 kg	
		*(2) Belmark 300 EC	450 mL	
		(3) Imidan 50% WP	3.75 kg	
SUMMER SPRAYS	Pear Psylla (about July 10)	(1) [2]Guthion 50% WP	2.10 kg	To reduce the risk of resistance, DO NOT use a pyrethroid at this time if one was used at First Cover. Where excessive stickiness or high psylla populations persist, contact your Horticultural Crop Advisor or Pest Management Advisor for assistance.
		or [2]APM 50% W	2.10 kg	
		(2) Thiodan, Thionex 50% WP	5-6.75 kg	
		*(3) Decis 2.5 EC	700 mL	
		*(4) Ripcord 400 EC	250 mL	
		or Cymbush 12.5% WP	560 g	
		*(5) Ambush 500 EC	400 mL	
		or Pounce 384 EC	520 mL	

[2]Minimum period before reentry is 48 hours.
****Repeated applications of synthetic pyrethroids are discouraged.***
See "Pest Resistance", page 10.

PEARS (Continued)

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	COMMENTS
SUMMER SPRAYS (Continued)	Mites	(1) Kelthane AP-35 or Kelthane 187.5 EC (2) Carzol 92 SP (3) ethion 25% WP	4.50 kg 8.50 L 1.10 kg 6.75 kg	Examine orchards for red mite and rust mite injury about July 15-20 or 10 to 15 days after using a synthetic pyrethroid. DO NOT APPLY closer to harvest than the number of days given in Table 22, page 89. Alternate miticides. Carzol is harsh on beneficial mite species.
SECOND COVER	Pear Psylla Codling Moth	Use one of the materials listed under **PETAL FALL.** See Comments. **OR** Sevin 50% WP	 4.25 kg	 Sevin is not effective against older psylla nymphs.
	Sooty Blotch	Add one of: (1) captan 50% WP or captan 80% WP (2) zineb 80% WP	 6.00 kg 3.75 kg 6.00 kg	Repeat spray for sooty blotch two weeks later.
SPECIAL SPRAY About mid-August and early September	Obliquebanded Leafroller Codling Moth	(1) [2]Guthion 50% WP or [2]APM 50% W (2) Imidan 50% WP	2.10 kg 2.10 kg 3.75 kg	Where there has been a pest problem, consult the local OMAF advisor for a more specific control strategy for your situation. Codling Moth as well as Oriental Fruit Moth can infest pears as maturation and ripening begins. Bosc pears can be heavily infested and may require two pre-harvest sprays about 2 weeks apart. For Bosc, Anjou and Bartlett a spray 7 to 10 days prior to harvest is recommended in orchards adjacent or nearby peaches.

Notes:

A. MEALYBUG: Where this has been a problem spray at **PETAL FALL** and **FIRST COVER** with [3]parathion 15W at 2 kg per 1000 L. A high-volume spray is necessary for good control.

B. MITE CONTROL: Early season sprays are necessary for good mite control. Oil is not effective for the rust mite, but those miticides listed for **PREBLOOM** and **PETAL FALL** will control both the rust mite and European Red Mite.

C. DIKAR WP: When used in a full-season program at 10-day intervals, Dikar at 6 kg/ha will control pear scab and nymphal stages of pear psylla. It will also suppress European red mite and rust mite populations. It must not be used within 30 days of harvest. Higher water volumes aid in mite suppression. Consult label.

POLLINATION: All varieties in Ontario are commercially self-unfruitful, and mixed plantings are necessary. Insects are required for cross-pollination. Honeybees do not find pear blossoms as attractive as most other fruit. Careful timing of the introduction of honeybees to orchards is necessary. Up to 8 hives per hectare are recommended to be placed when the orchard is about 25% in bloom. The use of pollen inserts will help to overcome this problem. See page 8, and also OMAF Publication 72, "Pollination: Crops and Bees".

[2]Minimum period before reentry is 48 hours.
[3]Minimum period before reentry is 7 days.

GUIDELINES FOR PROTECTING YOUNG NON-BEARING PEAR PLANTINGS

The following program is designed to offer **limited protection when needed for newly planted trees.** It is not intended to be used for protection of bearing orchards. Other protective measures include removal of neglected fruit trees in the area, careful selection of intercrops (where used) and a clean, weed-free environment. Rates are for dilute spraying. Alternate materials are available as shown in the calendar for bearing fruits.

DISEASES AND INSECTS	MATERIALS	AMOUNT PER 1000 LITRES	COMMENTS
Fire blight	Agri-Mycin 17	600 g	Avoid overstimulating growth. See page 15.
Pear psylla	Morestan 25 WP	2.0 kg	If nymphs are observed spray when 75% of the petals have fallen in a bearing orchard. Also controls mites.
Leaf-feeding insects	Imidan 50 WP	1.25 kg	Apply at any time when small caterpillars are feeding.
Pear psylla (summer broods)	Thiodan, Thionex 50 WP	1.5 kg	Apply when early nymphal stages are present.
European Red Mite	Morestan 25 WP	750 g	Check foliage frequently and spray if 7-10 mites/leaf are observed or at first sign of leaf bronzing. This material will also control pear psylla when used at a higher rate. See pear psylla above.

EMERGENCY PROCEDURES FOR PESTICIDE POISONING & FIRST – AID INFORMATION
(see back cover)

PLUMS

Read the label and follow all safety precautions. For dilute spraying refer to page 17. "GUIDE FOR SPRAYING TREE FRUITS"

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	COMMENTS
GREEN TIP Just as buds are bursting	European Red Mite Scale Insects	(1) superior oil (2) ethion superior oil	60 L 60 L	Spray on a calm day to improve coverage.
	European Red Mite only	superior oil concentrate	15 L	
PREBLOOM When blossoms show white	Brown Rot	(1) captan 50% WP or captan 80% WP (2) sulphur 92% WP (3) Funginex 190 EC (4) Phygon-XL 50% WP	6.00 kg 3.75 kg 20.25 kg 2.50 L 1.75 kg	To help control brown rot, knock off mummied fruit when pruning. Also, cultivate entire orchard before bloom. Sulphur helps control Eriophyid mites on European plums and prunes. Captan may cause injury, under some circumstances. Injury has occurred on Grand Prize, Early Golden, Shiro, Burbank and Ozark Premier. Make two to three applications from early to full bloom. Do not use Phygon for 5 days after frost. Do not use when temperatures are above 29°C. Do not use within 10-14 days of Bordeaux or oil.
	Black Knot	(See note on black knot, page 51).		
DO NOT APPLY INSECTICIDES WHEN PLUM TREES ARE IN BLOOM. See note on pollination, page 8, and also OMAF Publication 71, "Honey Bees and Pesticides".				
SHUCK When most of the shucks are off	Brown Rot	(1) sulphur 92% WP (2) captan 50% WP or captan 80% WP	20.25 kg 6.00 kg 3.75 kg	Captan can cause leaf injury and spotting of the fruit on Japanese plums under some circumstances.
	Plum Curculio	Add one of: (1) [2]Guthion 50% WP or [2]APM 50% W (2) Imidan 50% WP (3) [3]parathion 15% WP	 2.00 kg 2.00 kg 3.75 kg 3.25 kg	If temperatures are high, spray when the shucks split.
	European Red Mite	Add one of: (1) Omite 30 WP (2) Kelthane AP-35 or Kelthane 187.5 EC	 5.5 kg 4.5 kg 8.5 L	If oil was not used at **GREEN TIP**, a second spray for mites is due at this time. See note on **EUROPEAN RED MITE** at the end of Plum calendar.
		RESISTANCE TO MITICIDES IS INCREASING IN ONTARIO ORCHARDS. SEE "PEST RESISTANCE", PAGE 10.		
FIRST COVER 12 days after SHUCK	Brown Rot Leaf Spot	Use one of the fungicides listed under **SHUCK.**		
	Plum Curculio	Use one of the insecticides listed under **SHUCK.**		
SUMMER SPRAY	European Red Mite	Use one of the miticides listed under **SHUCK.**		See note on **EUROPEAN RED MITE** at end of Plum calendar.

SECOND COVER	Brown Rot	(1) sulphur 92% WP (2) captan 50% WP or captan 80% WP	20.25 kg 6.00 kg 3.75 kg	During wet weather repeat applications between pickings. Check interval to harvest for materials. See page 89.
PRE-PICK	Brown Rot	Use one of the fungicides listed under **SECOND COVER.**		

Notes:

APHIDS: If aphids are a problem, spray with one of:

(1) Thiodan, Thionex 50 WP	3.25 kg/ha
(2) diazinon 50 WP	3.00 kg/ha

Very thorough coverage and calm, warm conditions are needed for good control.

PEACH TREE BORER: If a problem, spray as directed for **PEACHES,** see page 43.

POLLINATION: Both European and Japanese plums should be considered as self-unfruitful. Mixed plantings and insect pollinators are essential. Honeybees readily work plum blossoms. See OMAF Publication 72, "Pollination: Crops and Bees".

BLACK KNOT: Destroy affected wild plums and neglected plums near orchard. Cut out and burn all black knots before March. Make the cut 15 cm below the swelling. Collect and burn all prunings bearing knots.

Knots left lying on the ground are a source of spores that start new infections. Inspect all plums in early summer for new knots and those that were missed. Cut these out and burn them. European plums, prunes and damsons are most susceptible. There is no fungicide registered for black knot control. Research results indicate that full rates of Phygon or captan (3-4 sprays) applied from the popcorn stage (prebloom) to first cover will reduce infections up to 90%. Fungicide sprays should be applied to protect green tissue against infection by the black knot spores which are primarily present during this period. This release of spores may be delayed in dry springs when rains are delayed until after bloom. During wet periods apply every 3 to 5 days.

APPLE MAGGOT: Where it has been a problem on blue plums and prunes, apply two or three sprays during July and early August. Consult Spray Service Circulars or Agriphone for more details.

Spray with one of:

(1) diazinon 50 WP	3.00 kg/ha
(2) [2]Guthion 50 WP	2.00 kg/ha
or [2]APM 50 W	2.00 kg/ha
(3) Imidan 50 WP	3.75 kg/ha

HEAT SPOT: High temperatures may cause purplish spots on plum and prune fruits which exude clear gum. These spots develop about five to eight days after the hot spell. Summer cover crops and mulch help to reduce this physiological disease.

Spraying with 4 kg of calcium chloride in 1000 L of water during the period from early July to mid-August has been demonstrated to reduce this disorder on prunes. Three sprays, 10-12 days apart, should be applied.

EUROPEAN RED MITE: Mite control is difficult on plums and especially on prune varieties. Apply **GREEN TIP** and **PETAL FALL** sprays, or **PETAL FALL** and **SHUCK** sprays, using the recommended miticides. **SUMMER SPRAY** about mid-July if mites are found on leaves of susceptible varieties (especially prunes); spray thoroughly with one of the miticides listed after first cover but no closer than the number of days allowed before harvest.

[2]Minimum period before reentry is 48 hours.
[3]Minimum period before reentry is 7 days.

RASPBERRIES AND BLACKBERRIES

Do not use Guthion in knapsack or other home garden-type sprayers. Read the label and follow all safety precautions.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	AMOUNT PER 1000 LITRES	COMMENTS
	Do not spray closer to harvest than the number of days given in brackets. Unless otherwise stated, use at least 2000 L of water per hectare.				
DELAYED DORMANT TO GREEN TIP	Anthracnose and Spur Blight	DNOC liquid (Elgetol) (2) Lime Sulphur	15.0 L 52.5 L	10 L 35 L	DO NOT USE LATER THAN 1/4 INCH GREEN DUE TO PHYTOTOXICITY. Use 1500 L of water per hectare. This is the primary component of a good control program.
PREBLOOM until blossoms open	Anthracnose and Spur Blight	ferbam 76% WDG	4.5 kg	2.25 kg	Apply when canes are 25-30 cm tall and again just before first bloom.
	Powdery Mildew	Use one of: (1) Benlate 50 WP (1 day) (2) Easout 70 WP (1 day)	 1.1 kg 1.1 kg	 550 g 550 g	In problem patches, spray when mildew is first observed. Repeat in 7 to 10 days. A maximum of two sprays. See "Pest Resistance", page 10.
	Raspberry Sawfly	diazinon 50% WP	2.0 kg	1.0 kg	Diazinon will also provide some aphid and raspberry fruitworm control. Do not apply after first blossoms open.
	Raspberry Fruitworm	malathion 25% (1 day)	9.0 kg	4.5 kg	Repeat in 7 to 10 days where there has been a history of injury.
	Spring feeding Caterpillars and Leafrollers	(1) Guthion 50% WP or APM 50% WP or [2]Guthion Solupak 50 WP	1.75 kg 1.75 kg 1.75 kg	875 g 875 g 875 g	
SEE PAGE 9 FOR WAYS TO REDUCE BEE POISONING. DO NOT APPLY INSECTICIDES DURING BLOOM.					
BLOOM	Fruit rots on Raspberries	Use one of: (1) captan 50% WP (2 days) or captan 80% WP (2 days) (2) Benlate 50% WP plus captan 50% WP (2 days) (3) Dyrene 50% WP (14 days)	 4.0 kg 2.5 kg 1.1 kg 4.0 kg 5.0 kg	 2.00 kg 1.25 kg 550 g 2.0 kg 2.5 kg	Repeat every 7 days to the end of bloom if wet. Because fungus can become resistant to Benlate, mixture with captan is recommended.
POSTHARVEST As soon as crop harvest is complete	Leafhoppers	Use one of (1) [2]Guthion 50% WP (7 days) or [2]Guthion Solupak 50% WP (7 days) (2) malathion 25% WP (1 day)	1.1 kg 1.1 kg 9.0 kg	700 g 700 g 4.5 kg	
	Powdery Mildew	Use one of: (1) Benlate 50% WP (2) Easout 70% WP	 1.1 kg 1.1 kg	 550 g 550 g	Repeat every 14 days if disease becomes evident on new growth.

Anthracnose and Spur Blight	ferbam 76% WDG	4.5 kg	2.25 kg	Remove and destroy old canes immediately after harvest.
Two-spotted Spider Mite	(1) Kelthane 187.5 EC	9.0 L	4.5 L	Good weed control and removal of fruiting canes immediately after harvest will also reduce the pressure of this pest.

[1]Minimum period before reentry is 48 hours.

PART A: SPECIAL CULTURAL PRACTICES FOR THE CONTROL OF ROOT, CANE AND FRUIT ROT DISEASES

a. Plant on well-drained soil and on a site with good air circulation.

b. Space rows at least 2.5 m apart. Limit width of plants within row to 30-45 cm. Plant stand should be thinned to 12-15 plants per running metre of row.

c. Immediately after harvest is finished, remove old canes, plus diseased and spindly new canes from field and then burn tips.

d. Keep rows free from weeds.

e. In spring, prune out and burn canes or portions of canes showing swelling, scars and cracks.

PART B: INSECTS

1. **Cane Borer:** Canes girdled with two rings 15 mm apart. Examine canes frequently in June and July. Cut off wilted tips below lower ring as they appear and burn.

2. **Sap Beetles:** Black beetles with cream markings infest berries in boxes. No chemical sprays give satisfactory control. Never put boxes of berries on ground. Remove from planting to screened building or shelter immediately after picking. For small plantings, use baits consisting of: (a) apple cider vinegar (1 L) plus 1 teaspoon full of either Sevin or Thiodan, Thionex and place in small jars with large wire mesh covers throughout planting. Renew bait every few days; (b) mashed bananas or chopped up immature sweet corn mixed with Thiodan, Thionex 50 WP at the rate of 500 g per 25 kg (3 level teaspoons per 1 kg) of ground material. Place bait on disposable pie plates (about 100 g per plate) and cover with second perforated plate. Distribute traps at 16 m intervals. Renew with fresh bait each week. Dispose of old bait and used pie plates by burying. **KEEP BAIT OUT OF REACH OF CHILDREN, PETS AND LIVESTOCK.**

3. **Raspberry Crown Borer:** If more than 5% of the crowns are infested, apply a drench to the crown area. Infested plantings should be treated for at least two years in a row.

   Fall Treatment: Mid-September to mid-October. Drench crown area using Diazinon 500 EC 1.0 L (50 WP – 1.0 kg) per 1000 L of water. Apply 4000 to 5000 L of spray mixture per hectare.

   Spring Treatment: When new growth appears. Apply treatment as above.

4. **Nematodes:** Damage from nematodes causes stunted, straggly canes. See page 78.

PART C: DISEASES

1. **Viruses:** Viral diseases such as mosaic and leaf curl are the main causes of low yields and poor quality fruit. The following steps will help minimize virus spread:

   a. Plant virus-tested certified stock.

   b. Destroy all nearby wild raspberries and blackberries.

   c. Set new plantation at least 16 m from older plantations. Red raspberries should not be planted close to purple and black raspberries.

   d. Rogue out and completely destroy all virus infested plants as soon as symptoms of mosaic or leaf curl appear.

2. **Crown Gall:** Do not plant canes affected with crown gall. Do not plant clean canes in infected soil. Avoid injury to crown and roots. Maintain good soil fertility.

3. **Phytophthora Root Rot of Raspberry:** A disease complex characterized by patches of dying or stunted canes with yellow leaves and small fruits. These symptoms are similar to those caused by wet soil conditions and/or winter injury. Diseased canes have major roots with a distinct margin between the reddish-brown infected tissue and the green healthy tissue, which may extend halfway around the root and run along its length.

   Chemical control for New Planting: Use 150 mL of Ridomil 240 EC as a drench treatment per 100 m of row, 1 m wide, centered over the row. Apply in the spring after planting, and again in the fall (mid-October, but no later than October 31). Drench with at least 2500 L of water per hectare.

   Chemical control for Established Plantings: Apply Ridomil 240 EC at the above rate but only in the fall (mid-October but no later than October 31). Ridomil should not be applied in the spring on established plantings.

4. **Verticillium Wilt (bluestem):** Do not plant following tomatoes, potatoes, eggplants, or peppers and do not interplant with these crops.

   Red raspberries: Cut out and destroy infected canes.

   Black and purple raspberries: Dig out and destroy infected plants.

   See page 79 for preplanting soil fumigation treatment.

5. **Orange Rust of Blackberry:** Bright orange pustules appear on the lower surface of leaves. Dig out and destroy infected plants early in the spring before pustules break open.

PART D: DEER AND RABBIT

Apply Hinder on the plants at a rate of 3 to 5 L of product per 100 L of water. The main active ingredient of Hinder is ammonium soaps of higher fatty acids. It works as a scent repellent rather than a taste repellent.

Re-treatment may be necessary after heavy rainfall. Hinder may be applied to food crop plants up to 14 days before harvest.

STRAWBERRIES – ESTABLISHMENT YEAR (NEW PLANTING)

CULTURAL CONTROLS OF PESTS

These techniques should be incorporated into your farming system in an effort to suppress pest populations. This may result in reducing our dependency on chemical controls.

TIME	DISEASES AND INSECTS	CULTURAL PRACTICE	COMMENTS
BETWEEN PLANTINGS	White Grub Wireworms	Crop Rotation	Consider cultivated row crops such as snap beans, white beans, cabbage, broccoli, Brussels sprouts and cauliflower. Avoid preferred hosts such as corn, grasses, cereal species and potato.
	Root-Lesion Nematode White Grubs Root Weevil Wireworms Annual Weeds Two-spotted Spider Mite	Summer Fallowing	Cultivate to 10 cm (4 in) frequently enough to kill young weeds and discourage weed growth. Intervals between cultivations will vary according to rainfall and weed pressure. This practice should be avoided on sloping land prone to erosion. Sow oats or spring wheat in September as a cover crop to minimize soil erosion by wind and water. **DO NOT USE CEREAL RYE, AS THIS ENCOURAGES NEMATODES.**
	Perennial Weeds		For more details on preplant weed control, consult OMAF publication 75, *Guide to Weed Control*. Refer to the "Site Preparation" and "Special Methods of Weed Control" sections.
BEFORE PLANTING	Verticillium Red Stele Leather Rot Black Root Rot	Site Selection Crop Rotation	Select a site with good soil drainage. Avoid heavy poorly drained soils. Avoid sites diagnosed with a history of red stele and *Verticillium*. Specifically for *Verticillium*, avoid susceptible crops preceding strawberry such as potato, tomato, peppers, eggplant and alfalfa.
	Botrytis Fruit Rot Leaf Scorch Leaf Spot Leaf Blight	Site Selection	Select a planting site with good air drainage. Plants should be exposed to direct sunlight and rows planted parallel with the direction of the prevailing winds to promote fast drying of foliage and fruit.
	Root Weevil Cyclamen Mite	Isolation	Isolate new plantings from older infested plantings to provide a physical barrier to avoid land migration of these pests.
	Red Stele Verticillium	Cultivar Selection	The following varieties have some degree of resistance to the Red Stele fungus (*Phytophthora fragariae*): Annapolis, Cornwallis, Sparkle, Tribute, Tristar, Vantage and Veestar. See "Strawberry Variety Disease Ratings" at the end of the Strawberry Calendar for more information. *Verticillium* resistant varieties include: Annapolis, Cornwallis, Governor Simcoe, Settler, Tribute, Tristar, Vantage and Veestar. Use only plants which have been grown under the guidelines of the Ontario Superior Plant Propagation Program or similar programs elsewhere.

CHEMICAL CONTROL OF PESTS

Read the label and follow all safety precautions. When spraying, use enough water to thoroughly wet plants.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	COMMENTS
IN THE FALL BEFORE PLANTING	Nematodes only			See page 78 for information on fumigation as well as page 54 for cultural methods of nematode control.
	Verticillium			See page 78 for information on fumigation as well as page 54 for cultural methods of *Verticillium* control.
Use only plants which have been grown under the guidelines of the Ontario Superior Plant Propagation Program or similar programs elsewhere.				
AFTER PLANTING	Cutworms	Use one of: (1) Sevin 50 WP (2) poisoned bait	 2.25 kg	Sprays of Sevin will control above ground cutworms only. **POISONED BAIT:** Thoroughly mix 5 kg bran with Sevin 50 WP, and water (about 5 L). Broadcast freshly prepared bait at dusk on a warm evening at 10 kg/ha. **KEEP BAIT OUT OF REACH OF CHILDREN, PETS AND LIVESTOCK**
EARLY JUNE	Strawberry Leafroller	Use one of: (1) [3]parathion 15% WP (2) [2]Guthion 50 WP or [2]APM 50 W (3) malathion 25% WP	 1.75 kg 1.5 kg 1.5 kg 4.5 kg	Use sufficient water to wet plants thoroughly.
ONE MONTH AFTER PLANTING and again ONCE OR TWICE AT 2-WEEK INTERVALS	Leaf Blight Leaf Scorch Leaf Spot	Use one of: (1) bordeaux (2) Cyprex 65 WP or Equal 65 WP	 5-5-1000 L 1.75 kg 1.75 kg	Spray susceptible cultivar such as Bounty, Kent, Veestar, Tristar, Micmac and Tribute. Spray bordeaux alone. For instructions on mixing bordeaux see page 16. Cyprex of Equal may injure plants under cold weather conditions. Alternate between (1) and (2) to reduce the development of resistance.
JULY TO MID-AUGUST	Potato Leafhopper	Use one of: (1) [3]parathion 15% WP (2) [2]Guthion 50 WP or [2]APM 50 W (3) malathion 25% WP	 1.75 kg 1.5 kg 1.5 kg 4.5 kg	Repeated applications may be necessary for leafhopper control.

[2]Minimum period before reentry is 48 hours.
[3]Minimum period before reentry is 7 days.

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	COMMENTS
FALL	Red Stele	Ridomil 240 E	4.2 L	This application is only necessary where there has been a history of Red Stele on the farm. One application should be made in early September, and a second treatment in late October, but not later than October 31. Apply as a broadcast application in sufficient water to ensure even coverage. If dry conditions prevail at time of application, use sufficient water volume (2500 L/ha) to ensure movement of Ridomil into root zone. Resistance of Red Stele fungus has been confirmed in Canada. To reduce the chances of resistance development, **only** apply Ridomil where Red Stele has been observed and confirmed. See "Cultural Controls for Pests of Strawberry", page 54.

STRAWBERRIES – YEARS OF BEARING FRUIT

CULTURAL CONTROLS OF PESTS

These techniques should be incorporated into your farming system in an effort to suppress pest populations. This may result in reducing our dependency on chemical controls.

TIME	DISEASES AND INSECTS	CULTURAL PRACTICE	COMMENTS
LATE APRIL TO EARLY MAY	Plant Bugs Spittle Bug Two-spotted Spider Mite Botrytis Fruit Rot Leather Rot	Weed Control (Chemical or hand)	Broadleaf weeds provide alternate hosts and encourage the subsequent build up of resident plant bug and two-spotted spider mite populations. Grass fence rows of volunteer grass in the planting provides alternate hosts and subsequent build up of resident spittle bug populations. Weeds keep relative humidity high and slow down the drying out of the plants, thus encouraging fruit rots.
MID TO LATE MAY	Leather Rot	Straw Mulch	A straw mulch thick enough to prevent soil from splashing onto berries should be applied at petal fall and prior to significant berry formation.
	Botrytis Fruit Rot Leather Rot Black Root Rot	Fertilization	Avoid excessive fertilization which can encourage too much foliar growth, resulting in a dense, humid canopy.
PRE-HARVEST TO HARVEST	Botrytis Fruit Rot Leather Rot Black Root Rot Verticillium Red Stele	Irrigation Scheduling	Adjust timing of irrigation for evaporative cooling and drought relief to mid-day (10:00 am - 3:00 pm) with short periods of water application to allow foliage and fruit to dry out before nightfall. Avoid puddling of heavier soil types by applying too much water at one time.
RENOVATION (EARLY JULY)	Two-Spotted Spider Mite Powdery Mildew	Mowing	Mowing off of strawberry leaves eliminates the food source for these pests, thus reducing population numbers.

	Botrytis Fruit Rot Leather Rot	Narrowing Rows	Narrowing the width of the matted row to 30 cm (12 in) decreases plant density and encourages aeration and quick drying of the crop canopy. Incorporating plant crop residues into the soil by rototilling helps destroy the main source of *Botrytis*. If runnering is too vigourous, rows can be narrowed again in October using a coulter.
RENOVATION	Black Root Rot	Subsoiling	Subsoiling in late July-August can reduce compaction and improve the drainage of the soil.

CHEMICAL CONTROL OF PESTS

(See Guidelines for Spraying Strawberries, page 60)

DO NOT SPRAY closer to harvest than the number of days indicated in brackets following materials (see Table 22, page 89).

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	COMMENTS
FIRST SPRAY WHEN FLOWER BUDS ARE VISIBLE IN CROWN	Leaf Blight Leaf Scorch Leaf Spot	Use one of: (1) bordeaux (2) Cyprex 65 WP (7 days) or Equal 65 WP (7 days)	 10-10-2000 L 1.75 kg 1.75 kg	Spray susceptible cultivars such as Bounty, Kent, Veestar, Micmac, Tristar and Tribute. Spray bordeaux alone. For instructions on mixing bordeaux, see page 16. Cyprex or Equal may injure plants under cold weather conditions. Alternate between (1) and (2) to reduce the development of resistance.
	Botrytis Fruit Rot	Use one of: (1) captan 50 WP (2 days) or captan 80 WP (2 days) (2) Folpan, Phaltan 50 WP (1 day) (3) Dyrene 50 WP (5 days)	 6.75 kg 4.25 kg 2.25 kg 3.25 kg	Early season spraying is the primary component of a good control program. Spray one or two applications during this period. Captan and Folpan give short residual control under wet conditions; reduce intervals to 3 to 5 days if wet. Dyrene may cause foliage injury if used surrounding a frost period.
AS FLOWER BUDS EXTEND FROM CROWN	Strawberry Clipper Weevil	Use one of: (1) [2]Furadan 480 F *(2) Cymbush 250 EC or Ripcord 400 EC (both 7 days)	 1.1 L 280 mL 175 mL	Check edges of fields for clipped buds. Apply insecticide when first injury is detected. Do not use Furadan later than bloom because of its toxicity to pollinating and beneficial insects. Use Furadan only once during the season. A second application may be required if new injury is detected 7 days after the first spray. Repeated use of Cymbush and Ripcord is discouraged. It may induce mite problems. See "Pest Resistance", page 10.
	Botrytis Fruit Rot	Use one of the fungicides listed for fruit rot above.		Blossom tissue injured by frost is more susceptible to Botrytis infection.

[2]Minimum period before reentry is 48 hours.
****Repeated applications of synthetic pyrethroids are discouraged. See "Pest Resistance", page 10.***

TIME TO SPRAY	DISEASES AND INSECTS	MATERIALS	AMOUNT PER HECTARE	COMMENTS
FIRST BLOOM	Plant Bugs	Use one of:		**DO NOT SPRAY WHEN BEES ARE WORKING, SPRAY IN EVENING.** See page 9. Cymbush or Ripcord will also control clipper weevil. Thiodan, Cymbush or Ripcord will also control spittlebug. Repeated use of Cymbush and Ripcord is discouraged. May induce mite problems. See "Pest Resistance", page 10.
		(1) Cygon 480 E	2.75 L	
		*(2) Cymbush 250 EC	280 mL	
		or Ripcord 400 EC	175 mL	
		(both 7 days)		
		(3) Thiodan 50 WP (7 days)	2.25 kg	
		or Thionex 50 WP	2.25 kg	
		*(4) Decis 2.5 EC	400 mL	
	Botrytis Fruit Rot	Use one of the fungicides listed for fruit rot in the **FIRST SPRAY**		Keeping all flower parts protected with fungicide during bloom is essential for good control of Botrytis. **Typically 2-3 sprays during bloom will give good control.** Dyrene may cause foliage injury if used surrounding a frost period.
7 TO 10 DAYS AFTER FIRST BLOOM	Plant Bugs	*(1) Cymbush 250 EC	280 mL	**DO NOT SPRAY WHEN BEES ARE WORKING, SPRAY IN THE EVENING.** See page 9 for ways to reduce bee poisoning. Repeated use of Cymbush and Ripcord is discouraged. May induce mite problems. See "Pest Resistance" page 10.
		or Ripcord 400 EC	175 mL	
		(7 days)		
		(2) Thiodan 50 WP (7 days)	2.25 kg	
		or Thionex 50 WP	2.25 kg	
		*(3) Decis 2.5 EC	400 mL	
	Botrytis Fruit Rot	Use one of:		Shorten intervals to 3 to 5 days if weather is wet. Use Rovral especially under wet conditions.
		(1) Rovral 50 WP (1 day)	2.0 kg	
		(2) Dyrene 50 WP (5 days)	3.25 kg	
		(3) Folpan, Phaltan 50 WP (1 day)	2.25 kg	
		(4) captan 50 WP (2 days)	6.75 kg	
		or captan 80 WP (2 days)	4.25 kg	
PREHARVEST	Botrytis Fruit Rot	Use one of:		If irrigation is necessary, water early in the day to allow plants to dry off before nightfall. **Do not use Rovral in consecutive sprays or more than two sprays per season.** Alternate with other fungicides. Do not exceed captan rate, or spray closer than 48 hours prior to picking to ensure legal residue levels (5 ppm).
		(1) Rovral 50 WP (1 day)	2.0 kg	
		(2) Folpan, Phaltan 50 WP (1 day)	2.25 kg	
		(3) captan 50 WP (2 days)	6.75 kg	
		or captan 80 WP (2 days)	4.25 kg	
	Leather Rot (Phytophthora)			See note C at end of strawberry calendar.

SPECIAL SPRAYS: Some insects and diseases are sporadic. This means these pests may require a control infrequently, eg. one in every five years, or maybe confined to certain areas of the province or farm or cultivars.

As Buds Extend From Crown or Immediately After Renovation	Cyclamen Mite	Thiodan 50 WP (7 days) *or* Thionex 50 WP	2.2 kg in 1000 L of water	Apply at 5000 to 8000 L of spray per hectare as a drench over the plant row.
Preharvest	Slugs	Metaldehyde Bait		Most insecticides listed above have some activity on slugs. Distribute bait along edge of rows but not on strawberry plants. Keep children and domestic animals from treated areas. Read label about poisoning. Very poisonous to dogs.
Post Renovation	Powdery Mildew	Benlate 50 WP	1.1 kg	Consider application on susceptible cultivars such as Governor Simcoe, Settler, 7210-5, and the Vineland series. Renovate old plantings immediately after harvest to decrease disease pressure.
Post Renovation (August)	Two-Spotted Spider Mite	(1) Kelthane AP-35 (2 days) (2) Omite 30 W (7 days) (3) ethion 25 WP (8 days)	2.75 Kg 5.5 Kg 2.25 Kg	Coverage of the undersides of leaves is essential for good control. Only about 5% of Ontario plantings require this treatment.
Post Renovation (September)	Leaf Blight Leaf Scorch Leaf Spot	Use one of: (1) bordeaux (2) Cyprex 65 WP (7 days) or Equal 65 WP (7 days)	 10-10-2000 L 1.75 kg 1.75 kg	Spray susceptible cultivars such as Bounty, Kent, Veestar, Micmac, Tristar, and Tribute. Spray bordeaux alone. For instructions on mixing bordeaux see page 16. Cyprex of Equal may injure plants under cold weather conditions. Alternate between (1) and (2) to reduce the development of resistance.
FALL	Red Stele	Ridomil 240 EC	4.2 L	This application is only necessary where there has been a history of Red Stele. Apply as an overall application in sufficient water (2500 L/ha) to ensure movement of Ridomil into root zone. **DO NOT APPLY** Ridomil later than October 31 or in the Spring on established plants. Resistance of Red Stele fungus has been confirmed in Canada. To reduce the chances of resistance development, only apply Ridomil where Red Stele has been observed and confirmed. See Cultural Controls for Pests of Strawberry, page 56.

Repeated applications of synthetic pyrethroids are discouraged.
See "Pest Resistance", page 10.

NOTES:

A. **White Grubs** are the larval stage of beetles, including European Chafer, June Beetle and Japanese Beetles. This complex of insects causes the greatest economic damage on land confined to shoreline areas along Lakes Erie and Ontario. The white grubs are c-shaped with tan or brown heads and six prominent spiny legs.

Recent monitoring of a few pick-your-own operations indicate that grass parking lots can serve as a large reservoir for the build up of grubs. Grass areas should be cared for similarly to turf or lawns. If 5 grubs per 1/10 of a square metre (1 square foot) are found, the area should be treated with chlorpyrifos. Two applications should be made between mid July to mid September, when eggs hatch and larvae begin to feed. Chlorpyrifos should be applied when soil is moist and grubs are feeding near the surface. Immediately after applying the insecticide, thoroughly water to allow the insecticide to come in contact with grubs in the root zone just below the thatch (or grass mat layer). Treatment is required usually once every two or three years.

B. **Root Weevils:** The most common species in Ontario are the black vine weevil, the strawberry root weevil and the rough strawberry root weevil. Infestations causing economic damage are not very common (in less than 5% of plantings). Larvae of weevils do not possess legs, which serves as a key feature in separating them from their beetle (white grub) relatives. The weevil adults possess the characteristic extended mouthpart in the form of a snout. The adults do not possess wings and migrate by crawling across land. The whole population being female means the egg laying potential is high, which could lead to a rapid build-up within 2 years of planting. When Furadan is applied for the control of strawberry clipper weevil, it should suppress existing root weevil populations by killing early emerging adults and some larvae which may still be feeding. However, this timing is too early to kill the majority of emerging adult and too late to kill most larvae which have already finished feeding on the roots. Peak emergence and egg laying by adults occurs in July after harvest is completed.

C. **Leather Rot:** The use of captan or Folpan has been observed to reduce the incidence of leather rot, although they are not currently registered for the control of this disease. Benlate and Rovral do not control leather rot. Leather rot is worse under cool, wet harvest conditions and where insufficient straw is applied allowing soil splash to occur.

D. **Deer and Rabbit:** Hinder can be used at a rate of 2 to 4 litres in 100 L of water. Apply 450 to 950 litres of spray solution per hectare. The main active ingredient of Hinder is Ammonium soaps of higher fatty acids. It works as a scent repellent rather than a taste repellent. **Retreatment may be necessary after heavy rainfall.** Hinder may be applied to food crop plants up to 14 days before harvest.

GUIDELINES FOR SPRAYING STRAWBERRIES

To find the nozzle size for a boom sprayer, do the following:

1. Divide the number of square metres per hectare by the swath width.

$$\frac{\text{10,000 (square metres)}}{\text{width}} = \text{travel distance (metres per hectare)}$$

2. $$\frac{\text{Travel distance (metres per hectare)}}{\text{Travel speed (metres per minute)}} = \text{spraying time (minutes per hectare)}$$

3. $$\frac{\text{Litres per hectare}}{\text{Minutes per hectare}} = \text{Litres per minute (for all nozzles)}$$

4. $$\frac{\text{Litres per minute}}{\text{Number of nozzles.}} = \text{Litres per minute per nozzle}$$

5. From manufacturers' charts (see pages 41-47, Publication 373, *Orchard Sprayers*), choose a nozzle to give this output at the desired pressure. Further guidance is found in Publication 513, *The Strawberry in Ontario*, page 28.

Results from a recent sprayer assessment show that several factors contribute to poor control of botrytis rot of blossoms and berries.

1. Booms having all nozzles above the crop give poor penetration and light deposits of spray material on lower surfaces of leaves and on calyxes of blossoms.
2. Air-blast row-crop sprayers spray well only the first three rows. Sides away from the sprayer get poorer coverage.
3. Conjet air-shear sprayers with drive nozzles penetrate well, especially when drop arms are used.
4. Drop arms on boom sprayers improve coverage greatly.
5. Speeds greater than 3 km/h with boom sprayers give poorer coverage.

STRAWBERRY VARIETY DISEASE RATINGS

	Leaf Spot	Leaf Scorch	Powdery Mildew	Botrytis Rot	Verticillium	Red Stele[1]			
						Race A-4	Race A-6	Race A-7	New Race
Allstar[2]	MR-S*	MR	MR	MR	HR-MR	MR	R	S	?
Annapolis	MR	MR	S	S	MR	HR	HR	HR	S
Blomidan	MR	MR	S	MR	S	S-MR	MR	HR	HR
Bounty	MR	MS	MR	MR	HS	S	S	HR	HR
Cavendish	MR	R	MR	MR	MR	HR	HR	HR	S
Chambly	R	MR	R	?	?	?	?	?	?
Cornwallis	MR	MR	MR	S	MR	HR	HR	HR	S
Glooscap	MR	MR	MR	S	S	S	S	S	S
Governor Simcoe	MR	MR	HS	MR	MR	?	S	?	S-MR
Honeoye	MR	MR	MR	MR	HS	S	S	S	S
Jewel[3]	HR	MR	HR	MR	S	?	?	?	?
Kent	HS	S	MR	S	S	S-MR	MR	S	S
Micmac	S	S	MR	S	S	S-MR	MR	S	S
Midway	MR	MR	S	S	S	?	?	?	?
Pajaro	S	S	R	MR	S	?	?	?	?
Raritan	S	S	S	MR	S	S	S	S	S
Redcoat	MR	MR	MR	HS	S	S	S	S	S
Settler	MR	MR	HS	MR	MR	?	?	?	?
Sparkle	S	MR	MR	MR	S	HR	S	HR	HR
Tribute	MR	MR	S	MR	R	R	MR	MR	?
Tristar	MR	MR	S	MR	R	R	R	MR	?
Vantage	R	R	R	MR	R	R	R	R	?
Veestar	S	MR	S	MR	MR	HR	S	HR	S
Vibrant	MR	R	S	MR	S	?	?	?	?
V 7210-5[4]	MR	S	ES	MR	S	?	?	?	?
V 7251-1[4]	MR	R	MR	MR	MR	?	?	?	?
V 7261-3[4]	R	R	R	MR	M	?	?	?	?

R-Resistant; HR-Highly Tolerant; MR-Moderately Tolerant; S-Susceptible; ES-Extremely Susceptible; ?-Unknown.

[1]Red Stele ratings from Dr. N. Nickerson and Dr. A. Jamieson, Agriculture Canada, Kentville, Nova Scotia, (1989).
Race A-4, A-6, A-7 – Varieties tested against Nova Scotia strains of Red Stele.

[2]Dr. Gene Galletta, USDA, Maryland (1991).

**Race dependant.*

[3]Dr. Marvin Pritts, Cornell, NY (1991).

[4]These cultivars were previously known as Selkirk (V 7210-5), Scotland (V 7251-1) and St. Williams (V 7261-3).

FERTILIZER GUIDE FOR FRUIT CROPS

ORGANIC AMENDMENTS TO SOILS FOR FRUIT CROPS

Soil organic matter plays an important role in maintaining good soil structure, aeration and water penetration. Organic matter broken down by cultivation should be replaced by the addition of organic amendments. In vigorous sod orchards, the use of organic amendments is not usually necessary as sod culture returns organic matter to the soil.

Manure is an important organic amendment that contains considerable amounts of nitrogen and potassium, and smaller amounts of phosphorous. When manure is used fertilization rates should be reduced as indicated in Table 7, below. All manure is extremely variable in nutrient and dry matter content. One factor contributing to this variability is the source of manures. Poultry manure is higher in nitrogen than other sources and must be used with caution. No more than 7 tonnes of poultry manure per hectare should be applied per year. This would be approximately equivalent in nutrient value to 20 cubic metres of liquid poultry manure, 40 tonnes of cattle manure or 100 cubic metres of liquid cattle manure. Hog manure is slightly higher in nitrogen than cattle manure. No more than 35 tonnes of solid hog manure or 65 cubic metres of liquid hog manure should be applied per hectare. For more information on Manure for Orchards and Vineyards, consult page 67.

In the Niagara area, paper mill sludge has been used in orchards and vineyards to maintain soil organic matter. Rates will depend on the nitrogen content of the sludge and be in the range of 25-30 tonnes per hectare.

Straw or spoiled hay are other excellent sources of organic matter. As manure becomes more difficult to obtain and costly, straw or hay will be more widely used. Seven tonnes per hectare of straw or old hay will supply approximately the same amount of dry matter as 22 tonnes per hectare of cattle manure.

The nutrient content of old hay and straw varies. Legume hay contains approximately three times as much nitrogen as non-legume hay or straw. When non-legume hay or straw is incorporated into the soil, extra nitrogen is required to facilitate the breakdown of this dry matter and avoid nitrogen starvation. If 7-10 tonnes/ha of non-legume hay or straw is incorporated, apply 25-30 kg of nitrogen per hectare. Extra nitrogen is not required if legume hay is used.

FERTILIZER ANALYSIS

Fertilizers are guaranteed in terms of N (nitrogen), P_2O_5 (phosphate) and K_2O (potash). The amount of fertilizer to apply can be determined by multiplying the N, P_2O_5, or K_2O needed by 100 and then dividing by the % of that element contained in the fertilizer material. For example, 10-20-30 is a complete fertilizer because it contains all three elements. It contains 10% nitrogen – 20% phosphate – 30% potash. If the fertilizer report indicates 100 kg of nitrogen per hectare, it would be necessary to add 1000 kg of 10-20-30 per hectare to achieve this rate since this fertilizer contains 10% nitrogen. Fertilizers are available with different nutrient ratios and bulk blended fertilizer can be mixed for specific nutrient requirements. The type and amount of any one fertilizer to use is calculated on the percentage of the nutrients contained in the material, and the nutrient requirements indicated by soil or leaf analyses.

NITROGEN EQUIVALENT TABLE

Different sources of N fertilizer supply different amounts of nitrogen. Table 8 shows the different rates of some common nitrogen sources that are needed to supply the same amount of nitrogen. For example, 44 kg of ammonium nitrate is equivalent to 97 kg calcium nitrate, or 33 kg urea.

TABLE 8. AMOUNT OF NITROGEN FERTILIZERS REQUIRED TO SUPPLY SPECIFIC AMOUNTS OF NITROGEN

kg actual Nitrogen	Ammonium Nitrate (34% N)	Ammonium Sulfate (21% N)	Potassium Nitrate (13% N)	Calcium Nitrate (15.5% N)
	required kg of fertilizer material			
5.0	15	24	38	32
10.0	29	48	76	64
15.0	44	72	115	97
20.0	59	96	154	130
30.0	88	144	230	194
40.0	118	192	308	259

TABLE 7. REDUCTIONS IN FERTILIZER APPLICATION WHERE MANURE IS APPLIED

Class of Livestock	Nitrogen (kg/ha) F. & W.**	Spr.**	Spr.C**	Phosphate P_2O_5 (kg/ha)	Potash K_2O (kg/ha)
Liquid Manure at 10 cubic metres/hectare (One cubic metre = 220 imp. gal; one cubic metre/ha = 90 gal/ac)					
Cattle, Mixed Livestock	5	10	12	4	16
Swine	8	15	19	7	14
Poultry	23	46	58	22	26
Solid manure at 10 tonnes/hectare (66 bu. or 2.40 cubic metres of solid manure = 1 metric tonne approximately. Ten t/ha = 4.5 ton/ac.)					
Cattle, Mixed Livestock	12	24	30	10	44
Swine	15	30	38	20	26
Poultry	70	140	175	75	96

***F. & W. denotes fall and winter applied manure; Spr. denotes spring applied and not covered immediately, including surface application after seeding; Spr. C. denotes spring applied manure injected or otherwise covered within one day of application.*

In deciding what nitrogen fertilizer to use, calculate the cost per unit of actual nitrogen (N). Under most conditions, the fertilizer which costs least per unit of actual nitrogen should be used. The one exception is Urea which should not be applied to organic debris commonly found in orchards because of nitrogen loss. For other comments on the preferred source of nitrogen to use, consult the information on fertilizers for each crop. Some fruit crops require specific forms of nitrogen.

LIME

The need for lime can be determined by testing the soil. For information on this test, consult Soil Samples, Leaf Analysis and Tissue Testing. To add lime when there is not a demonstrated need can lead to a high soil pH, fertility problems and is an added expense that is not warranted. Lime will neutralize the acidity of the soil and raise the pH if the right type and amount is properly applied. Under acid conditions some nutrients are not as readily available as desired. Excessive rates of lime, however, should be avoided since some nutrients are less available at high pH levels. Microbial activity may increase in the soil when the pH is properly maintained.

Lime will be much more effective if it is incorporated into the soil. Incorporation prior to planting is the preferred method of adjusting the pH.

The amount of lime required depends on the clay and organic matter content of the soil. The soil pH is used to determine when soil needs lime. A separate soil test, the buffer pH test, is made on soils needing lime to determine the amount of lime required. For soils needing lime, Table 9 may be used to determine the tonnes of lime required to reach a certain target pH value (based on the buffer pH). Dolomitic lime (high in magnesium) should be used on soils low in magnesium (Mg).

SOIL SAMPLES, LEAF ANALYSIS AND TISSUE TESTING

The Ontario Ministry of Agriculture and Food accredits private labs to analyse soil and leaf samples. Those labs accredited must meet certain standards of analysis. Growers are well advised to use accredited labs for best predictions of the nutrient needs of their fruit crops.

Leaf analysis, soil testing and tissue testing information may be obtained from your local OMAF office. Leaf analysis is presently available for apples, pears, peaches, cherries, and grapes (petiole analysis). This program has been well developed and standards exist for accurate interpretation. Nitrogen, potassium, calcium and magnesium analysis is offered in the basic service with boron, zinc, manganese and iron available on request. For crops not covered by this program (strawberry, raspberry, blueberry, etc.), it is

TABLE 9. LIME REQUIREMENTS TO CORRECT SOIL ACIDITY BASED ON SOIL pH AND SOIL BUFFER pH.

Buffer pH	Target soil ph = 6.5 Lime if soil pH below 6.1	Target soil ph = 6.0 Lime if soil pH below 5.6	Target soil ph = 5.5 Lime if soil pH below 5.1
Ground limestone required - t/ha (Based on an Agricultural Index of 75) Use dolomitic limestone for orchards and vineyards.			
7.0	2	1	1
6.9	2	1	1
6.8	2	1	1
6.7	2	2	1
6.6	3	2	1
6.5	3	2	1
6.4	4	3	2
6.3	5	3	2
6.2	6	4	2
6.1	7	5	2
6.0	9	6	3
5.9	10	7	4
5.8	12	8	4
5.7	13	9	5
5.6	15	11	6
5.5	17	12	8
5.4	19	14	9
5.3	20	15	10
5.2	20	17	11
5.1	20	19	13
5.0	20	20	15
4.9	20	20	16
4.8	20	20	18
4.7	20	20	20
4.6	20	20	20

possible to have analyses made for nutrient composition under the Tissue Analysis Services offered by various laboratories. The interpretation of these results is not as clearly defined and accuracy of recommendations may not be as good. With soil testing, phosphorous, potassium, magnesium, pH, and buffer pH are part of the basic service with options available for other nutrients.

The grower is responsible for the cost of the analysis. Details on accredited labs are available at O.M.A.F. offices.

Fruit analysis is a new technique that offers a guide to calcium needs and storage life of apples.

STRAWBERRIES

Strawberries are shallow-rooted and require soils well supplied with organic matter and high in fertility. Preparation of the soil before planting is particularly important. Heavy manuring the year before planting (40-45 tonnes of cattle manure per hectare) is suggested. For information on other sources of manure to use, consult Organic Soil Amendments on page 62. Along with a liberal application of manure an adequately fertilized, weed-smothering, green-manure crop is recommended to build up organic matter.

A preplant soil test provides a good guide to phosphorous, potassium, magnesium, and pH requirements. Table 10, page 65, shows soil test values and fertilizer requirements for various fruit crops. For information on soil testing, consult Soil Samples, Leaf Analysis and Tissue Testing on page 63.

A soil pH below 5.6 on clay loam, and below 6.1 on sandy loam should be adjusted upwards by lime applications before planting. For more information on pH, consult Lime information on page 63.

It is not recommended that strawberries be inter-planted between young fruit trees because of the potential problems associated with pesticide usage on two different crops mixed together. However, if this is done, special fertilizing precautions should be observed. Late cultivation or too high a rate of nitrogen can stimulate tree growth late in the season. Nitrogen starvation of trees may also occur when the straw mulch is incorporated. When large amounts of straw are worked into the soil, extra nitrogen (approx. 50 kg N/ha) should be applied to ensure that nitrogen starvation of the trees does not occur. Long-term tree performance should not be sacrificed for the short-term intercrop.

Nitrogen (N)

Both established and new plantings of strawberries require annual applications of nitrogen. The timing of nitrogen application is as important as the rate of nitrogen. Improper timing and/or rates of nitrogen will give undesirable results such as increasing the susceptibility of plants to winter injury, soft fruit rot and other fruit disorders.

For new Plantings Nitrogen is required for successful field establishment. Apply 50 kg N/ha before planting or as a side dressing, two to three weeks after planting. See Table 8 for the nitrogen content of common nitrogen fertilizers. An additional 25-35 kg N/ha should be applied in mid-August to further invigorate plants as they initiate fruit buds for the following year's crop. Adjust nitrogen rates proportionately if manure has been applied. See Table 7 to determine the adjustments required if manure has been used.

For Established Plantings Spring applications of nitrogen are not generally recommended, particularly on vigorous cultivars such as Redcoat. Such applications may excessively invigorate plants, resulting in softer fruit and heavy foliage canopies. This will increase the potential for *Botrytis* fruit rot. However, some growers with coarse-textured soils have reported benefits from applying low rates of nitrogen (10-20 kg N/ha) in the spring after mulch removal. Although spring-applied nitrogen may increase berry size, it will also delay maturity by a day or two. Established fields on sandy soils or fields suspected of having winter injury may benefit from light spring applications of nitrogen. Growers are urged to gain some experience in applying nitrogen in the spring on a portion of their plantings before making it a general practice on all their plantings.

The recommended timing for nitrogen application in established fields is at renovation. After mowing the foliage, apply 50 kg N/ha. An additional 25-35 kg N/ha is recommended in mid-August to assist the plant in forming next year's fruit buds.

Phosphorous (P)

The amount of phosphorous to apply before planting should be determined by a soil test. Soils differ in the amount of phosphorous they can supply to plants. Generally, fields that have been cultivated for a length of time will require less phosphorous than recently developed fields.

For New Plantings Apply the amount of phosphorous determined by soil testing. Consult Table 10, page 65. In the absence of a soil test, select and apply a medium rate of phosphorous from Table 10, page 65, depending on the cropping history of the field. If the transplanter allows, a starter solution should be used at planting. This will greatly assist the strawberry crown's establishment, particularly if the soil is cold. Phosphorous availability is significantly reduced when soil temperatures are low. Use a starter solution high in phosphorous, such as 10-52-10, 6-24-6 or 10-24-0. Follow the manufacturer's suggested rate of application.

For Established Plantings Phosphorous requirements should be determined by soil testing. Consult Table 10, page 65. Excessive phosphorous levels may cause zinc deficiency, especially on sandy soils. In the absence of a soil test, select and apply a medium rate of phosphorous from Table 10, page 65.

Potassium (K)

For New Plantings Soil tests are the only way to accurately determine the amount of potassium to apply. Consult Table 10, page 65. This nutrient leaches rapidly on coarse-textured soils. In the absence of a soil test, select and apply a medium rate of potassium from Table 10, page 65, before planting. Sidedressing of potassium is not generally recommended.

For Established Plantings Typically, the potassium requirements of an established strawberry field are applied at renovation, with the nitrogen and phosphorous. If soil test is available, consult Table 10, page 65. In the absence of a soil test, select and apply a medium rate of potassium from Table 10, page 65, at renovation. Excessive levels of potassium will induce magnesium deficiency, particularly on sandy soils.

TABLE 10. PHOSPHOROUS AND POTASSIUM REQUIREMENTS FOR HIGH BUSH BLUEBERRIES, STRAWBERRIES, RASPBERRIES, CURRANTS, GOOSEBERRIES

Phosphorous				Potassium		
		Phosphate Required kg P_2O_5/ha				
Soil Test (ppm P)	Rating	New Plantings	Established Plantings	Soil Test (ppm K)	Rating	Potash Required kg K_2O/ha
0-3		140	100	11-15		130
4-5		130	90	16-30		120
6-7		120	80	31-45		110
8-9	Low	110	70	46-60	Low	100
10-12		100	70	61-80		90
13-15		90	60	81-100		80
16-20		70	50	101-120		70
21-25		60	40	121-150		60
26-30	Medium	50	30	151-180	Medium	40
31-40		40	20			0
Above 40	High	0	0	Above 180	High	0

RASPBERRIES, CURRANTS AND GOOSEBERRIES

Adequate soil preparation before planting raspberries, currants and gooseberries is essential. The soil should be prepared so these perennial crops can maintain productivity and grow successfully in the same location for many years. The preferred soil is deep, well drained, has a good water retaining ability and a high organic matter content. For more information on organic matter, consult Organic Amendments to Soils for Fruit Crops, page 62. A soil pH lower than 6.1 should be raised by applying lime before planting. For information on lime, consult page 63.

All of the fertilizer should be applied in early spring. If the fertilizer is not broadcast over the entire planting, the rate should be reduced to the percent of the area receiving fertilizer.

Each year after turning in clean cultivated plantings, a green-manure crop such as ryegrass is recommended to help harden off the plants for winter. This crop should be sown as soon as harvest is over and no further cultivation should be done that year.

Nitrogen (N)

For raspberries, apply between 30 and 40 kg/ha of nitrogen in the planting year; in the second year, apply between 40 and 60 kg/ha; in all subsequent years, apply between 45 and 75 kg/ha. The lower rates should be used on unirrigated and heavier soil types. The higher rates should be used on irrigated and sandier soil types. Avoid applying excess nitrogen (N), since it can reduce the number of berries per cane and lead to lower yield.

For currants and gooseberries, apply 5 g of nitrogen per bush in the planting year; the next year, apply 10 g per bush; in all subsequent years, apply 20 g per bush. The rate of nitrogen should be adjusted based on plant growth.

For Nitrogen Equivalents, consult Table 8, page 62.

Phosphorous (P) and Potassium (K)

A soil test should be made before planting these crops and every year thereafter for maximum economic production. Base phosphorous and potassium rates on soil test results. In the absence of a soil test, it would be reasonable to assume phosphorous and potassium levels are in the medium range and fertilize accordingly. Consult Table 10, above, for soil test interpretation. Once established, soil samples should be taken from the soil where plants are rooted, not from between rows. Phosphorous must be incorporated prior to planting to correct phosphorous deficiencies. Phosphorous does not readily leach into the soil from surface applications.

Currants and gooseberries are sensitive to injury from the chloride contained in muriate of potash (0-0-60). Some root injury has also been observed on raspberries on sandy soil where muriate of potash has been used at high rates. On currants and gooseberries, and if high rates of potash are required on raspberries, use sulfate of potash or sul-po-mag.

HIGHBUSH BLUEBERRIES

Blueberries perform best on acidic, well-drained soils with a high organic matter content. Before planting blueberries, the soil must be tested to determine the soil pH and fertilizer requirements. Acidic peat moss should be incorporated with the soil in the planting hole to significantly improve plant establishment and development. For more information on Organic Soil Amendments, consult page 62.

pH Requirements

Blueberries require a soil pH between 4.2 and 5.0 for optimum growth and production. If the soil pH is too high, the soil should be acidified by incorporating elemental sulfur and/or acidic peat moss prior to planting. Acidic peat moss incorporated with the soil in the planting hole also provides

essential organic matter. *A soil pH above 6.5 usually cannot be lowered economically using sulfur or peat moss. For this reason, sites for blueberry production must be carefully selected.* Sulfur should be incorporated one year prior to planting to allow sufficient time for the sulfur to acidify the soil.

TABLE 11. AMOUNT OF SULFUR REQUIRED TO LOWER SOIL pH (kg/ha)

SOIL TYPE	EACH 1.0 pH UNIT	EACH 0.1 pH UNIT
sand	350	35
sandy loam	750	75
loam	1100	110

Example: The initial soil pH of a sandy loam soil is 6.2; the desired soil pH for blueberries is 4.8. The soil pH must be lowered by 6.2 - 4.8 = 1.4 pH units. Therefore, 1.4 X 750 = 1050 kg/ha of sulfur is required.

The soil pH should be checked annually in the plant row and sulfur added when necessary.

Nitrogen (N)

Highbush blueberries respond best to ammonium forms of nitrogen. Use ammonium sulfate (21% N) if the soil pH is above 5.0 and urea (45% N) if the pH is below 5.0. Avoid using the nitrate form of nitrogen on highbush blueberries.

In the spring after planting, apply 14 to 18 g of nitrogen per bush. Increase the rate of nitrogen each year by 4 to 6 g until a total of 36 to 48 g per bush is applied.

TABLE 12. RATE OF NITROGEN PER HIGHBUSH BLUEBERRY BUSH

AGE OF PLANTING (years)	RATE OF N (grams)
1	14-18
2	18-24
3	22-30
4	28-36
5	32-42
6+	36-48

Apply the nitrogen just prior to bud break. On sandy soils, apply two-thirds of the nitrogen at bud break and the other one-third at petal fall. Distribute the fertilizer in a circle from 30 cm around the plant to just beyond the spread of the branches. On older bushes, apply the majority of the fertilizer under the outer spread of the branches.

Phosphorous (P) and Potassium (K)

Apply phosphorous and potassium according to soil tests. Consult Table 10, page 65, for soil test interpretation. A single application of phosphorous at soil preparation time is usually all that is required. It is critical to correct phosphorous deficiencies prior to planting.

All of the required potassium should be applied early in spring under the outer branches of the bushes as described for nitrogen. Potassium can be mixed and applied with the spring nitrogen. Use sul-po-mag (22% potash, 11% magnesium) or potassium sulfate (50% potash). Avoid muriate of potash (0-0-60), since it contains chloride which can be toxic to blueberries.

Other Nutrient Requirements

Magnesium (Mg) deficiency may occur on blueberries. Soil and/or foliar applications of magnesium are required to correct this deficiency. For soil applications, 80 kg Mg/ha is required where a confirmed dificiency exists. Magnesium sulfate (Epsom salts, 9.5% Mg) or sul-po-mag (21% potash, 11% Mg) can be used for soil application. Since sul-po-mag contains potash, the rate of application should be adjusted to coincide with potash requirements. For foliar sprays, 1.9 kg Mg/1000 litres of water (20 kg magnesium sulfate, Epsom salts) with at least 2000 litres/ha should correct the deficiency. Annual foliar sprays may be necessary.

Iron (Fe) deficiency is common on blueberries if the soil pH is too high. Lowering the soil pH will correct this problem in most cases and is the preferred method of control. Foliar applications of iron chelates will temporarily correct the deficiency but annual sprays may be necessary. Consult the manufacturers' labels for details on rates and timing.

LEAF ANALYSIS

Leaf tissue analysis can be used to assess the nutrient status of the plants and to more accurately determine fertilizer requirements. Leaf samples should be taken in late July from halfway down the new shoot growth of the current season. At least 100 leaves should be collected from throughout the area being sampled to adequately represent the area. Areas with different soil, plant vigour, fertility programs, etc., should be sampled separately.

TABLE 13. STANDARD RANGES FOR NUTRIENT LEVELS IN HIGHBUSH BLUEBERRY LEAVES

ELEMENT	MINIMUM	MAXIMUM
Nitrogen	1.80%	2.10%
Phosphorous	0.12%	0.40%
Potassium	0.35%	0.65%
Calcium	0.40%	0.80%
Magnesium	0.12%	0.25%
Sulfur	0.12%	0.20%
Manganese	25 ppm	350 ppm
Iron	60 ppm	200 ppm
Zinc	8 ppm	30 ppm
Copper	5 ppm	20 ppm
Boron	25 ppm	70 ppm

For more information, see the section on Soil Samples, Leaf Analysis and Tissue Testing on page 63.

FERTILIZER FOR TREE FRUITS AND GRAPES

Leaf analysis in established orchards, (petiole analysis in grapes) is the best method of determining nutrient needs. The nutrient levels in the leaves most accurately reflects the uptake of nutrients by the crop. Soil analysis is also used in conjunction with leaf analysis to determine the nutrient status of the soil and to monitor soil acidity. A combination of both analyses best evaluates fertilizer and lime needs. For more information on these tests consult Soil Samples, Leaf Analysis, and Tissue Testing on page 63.

TABLE 14. NUTRIENT LEVEL RANGE (% DRY WEIGHT) OF MID-SHOOT LEAVES TAKEN THE LAST TWO WEEKS OF JULY FROM MATURE TREES

Leaf analysis	Nitrogen*		Potassium		Magnesium
	Low if below	High if above	Low if below	High if above	Low if below
APPLE					
Delicious, Crispin	2.2	2.7	1.4	2.2	0.20
Empire, Spy	2.1	2.6	1.3	2.1	0.20
McIntosh, others	2.0	2.5	1.2	2.0	0.20
PEACH	3.4	4.0	2.0	3.3	0.35
PEAR	2.0	2.6	1.3	2.0	0.20
CHERRY					
Montmorency	2.2	3.0	1.5	2.1	0.35

* *Leaf Nitrogen in non-bearing trees should be .2% higher.*
Apple trees on M.9 or M.26 rootstocks should be .2% higher.

TABLE 15. NUTRIENT LEVEL RANGE (% DRY WEIGHT) OF GRAPE PETIOLES TAKEN IN SEPTEMBER FROM MATURE VINES

Petiole analysis	Nitrogen		Potassium†		Magnesium
	Low if below	High if above	Low if below	High if above	Low if below
GRAPE					
Vinifera	0.8	1.4	1.2	2.3	0.60
Catawba, Fredonia	0.6	1.2	0.8	1.8	0.60
Other cultivars	0.7	1.3	1.0	2.0	0.60

† *Potassium levels will be higher with grapes grown on sandy loam soils.*

Nutrient uptake is affected by many orchard and vineyard conditions. Consequently, each year the nutrient levels will vary slightly depending upon the season. In order to obtain optimum growth and fruit quality, adequate levels of all nutrients must be present in the leaves and the relative amounts must be balanced. Even with optimum levels of nitrogen and potassium, poor growth can be attributed to low levels of magnesium, boron, zinc or other micronutrients which will be reflected in the leaf analysis. Further information is available in the current OMAF Factsheet on Leaf Analysis. For leaf analysis to be most effective, the same trees should be sampled each year and adjustments made to the fertilizer program on the basis of this leaf analysis. Consult Table 14 for leaf analysis nutrient level range for apple, pear, peach and tart cherries. Consult Table 15 for petiole analysis nutrient level ranges for grapes. These values will vary slightly from year to year depending on weather conditions. Fertilizer requirements are adjusted to the system of soil management, tree age, rootstock, soil type and previous fertilizer applications. Growth, fruit size, colour and storage quality, must also be considered in determining the fertilizer required.

Manure for Orchards and Vineyards

Animal manure contains varying levels of nutrients and organic matter. The disadvantage of adding manure to orchards and vineyards is that the nitrogen is released over a prolonged period of time.

The slow release means that the perennial crops continue to be supplied with nitrogen during the year, which can result in poor fruit colour, excessive terminal growth and delayed hardening of the woody tissue, making plants more susceptible to winter injury. The practice of putting manure around newly planted trees is not recommended because of potential winter injury problems. If manure is used, it should be broadcast at moderate rates and worked into the soil in late fall or early spring.

No more than 7 tonnes/ha of poultry manure (20 cubic metres liquid), 40 t/ha of cattle (100 cubic metres liquid), 35 tonnes/ha hog (65 cubic metres liquid) should be applied per hectare. Manure is extremely variable in nutrient content. When manure is used the rate of fertilizer should be reduced. Table 7, page 62, shows the varying average composition of some manures and the suggested reduction of fertilizer when manure is used.

pH Requirements

The pH of the soil is a measure of its acidity. If the pH is not at an acceptable level nutrient uptake and crop performance can be hindered. To determine pH take a soil sample. For information on soil sampling, consult Soil Samples, Leaf Analysis, and Tissue Testing, page 63. A soil sample should always be taken before establishing a new planting, as this is the best time to correct pH problems. If lime is required, it should be incorporated during soil preparation. In established orchards and vineyards a soil

sample in the tree or vine row is recommended every 3 years to be sure the pH is at a satisfactory level. If pH is low (acidic), lime can be applied to the sod cover in the fall, or before cultivation in the spring. The results will not be immediately evident because the lime moves slowly into the soil.

The target pH before establishing a new orchard or vineyard is 6.5 on sandy soils and 6.0 on clay soils. If the pH in established orchards is above 5.6, lime is not needed. In established orchards and vineyards, when the pH on clay loam soils drops below 5.1, and on sandy loam soils below 5.6, lime should be applied. This will raise the soil pH (reduce the acidity) and also supply calcium. Dolomitic lime (high in magnesium) should be used on soils low in magnesium. Rates of application will vary with soil type and initial pH. The buffer pH indicates the rate of lime to apply. For information on lime, consult Lime on page 63.

TREE FRUITS

Non-bearing

It is extremely important to start trees in a weed-free area that is kept clean, in the early part of each growing season, each year, until the trees are well established. A herbicide strip 1 to 1.5 metres wide, should be adequate if clean cultivation is not used.

Unless the soil is particularly nitrogen-deficient, no nitrogen fertilizer should be applied in the planting year.

During the early years before new trees bear their first crop, an annual application, early in the spring, of nitrogen and potash is usually required. For suggested rates, refer to sections which follow.

If the soil has been prepared properly, including deep cultivation and addition of organic matter, there should be an adequate supply of other nutrients to sustain the tree in the juvenile years. On coarse-textured, infertile soils, the use of a starter solution at planting time (e.g., 10-52-10 or 20-20-20) may give the trees a needed boost. High nitrogen levels can result in excessive growth and incomplete tree hardening. The use of green manure crops to check late season growth in cultivated orchards is strongly recommended, especially in new plantings.

On young trees the fertilizer should be broadcast under the spread of the branches at least 15 cm from the trunk, since injury can result if placed too close.

Bearing

Most bearing orchards require annual applications of both nitrogen and potassium fertilizer. These two elements have very significant effects on growth and productivity. Nitrogen is necessary for many tree functions including growth, fruit bud formation, fruit set, and fruit size.

It is important that nitrogen not be applied in excessive amounts. If too much nitrogen is applied or applied too late in the season, fruit colour and quality may be poor. Also, available nitrogen late in the season encourages the tree to grow instead of hardening off, and winter injury then becomes a possibility. The use of cover crops in cultivated orchards will help to lower the nitrogen level in the latter part of the season. Cover crops such as Italian rye grass, sown about July 1, will take up much of the available nitrogen in the soil and in this way have the desirable effect of checking tree growth. In herbicide-treated strips under trees, weed growth late in the season will take up extra nitrogen and assist in hardening off trees and improving fruit quality.

Nitrogen (N)

Cultivars differ in their nitrogen requirements. A cultivar grown for processing could receive more nitrogen than one for the fresh market. In some situations, if fruit tends to be small, more nitrogen may be needed. Rootstocks, spacing and pruning also have an influence. If pruning is to be severe, nitrogen rates should be cut back or eliminated for a year. Tree growth, foliage colour, fruit colour including quality and storeability, nutrient balance in leaves and soil are also important considerations. Beause of the complexity of nitrogen interactions with quality and production, the best guide for nitrogen rates is leaf analysis.

Soil application of urea (46-0-0) to sod orchards is not recommended since some of the nitrogen may be lost by volatilization. There are several form of nitrogen available but ammonium nitrate (34-0-0) has been shown to be the most economical form of nitrogen to use. If you are using blended fertilizers for your orchard, request ammonium nitrate as the N source.

For apple, pear, peach, plum, and cherry orchards where leaf analysis is not available, the following rates could be considered normal.

TREES 1-6 YEARS OF AGE REGARDLESS OF DENSITY For each year of tree's age, apply between 30 and 40 g of N (90-120 g ammonium nitrate). Thus, a 5-year-old tree in sod orchard would require 150-200 g of N. The rate for cultivated orchards can be cut by 1/2, as competition for nutrients is greatly reduced.

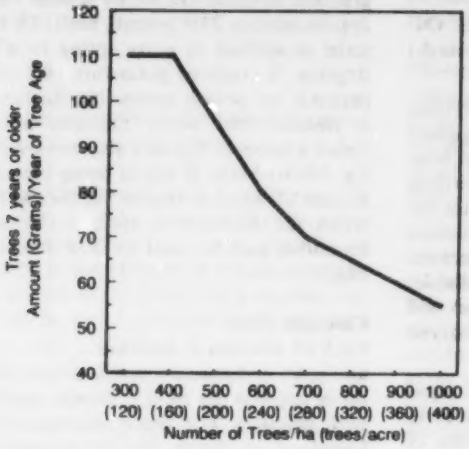
TREES 7 YEARS OF AGE OR OLDER Trees on dwarfing rootstocks generally require more nitrogen per hectare (not per tree) than trees on more vigorous stocks. When fertilizing trees on dwarfing rootstocks consult Figure 2, Ammonium Nitrate Rates for Established Orchards, for approximate nitrogen adjustments at varying tree numbers per hectare. **When the tree canopy has covered the space available, nitrogen fertilizer requirements will level out and will not increase indefinitely with tree age.** Again leaf analysis is the most reliable guide.

For all tree fruits do not exceed the maximum rates of 200 kg/hectare per year even in the case of a severe deficiency.

Nitrogen Placement and Timing Nitrogen fertilizer should be applied in early April to allow proper utilization. In cultivated orchards nitrogen should be broadcast under the tree canopy. In sod orchards the nitrogen should be placed in a band under the drip line or in the herbicide strip.

FIGURE 2.

AMMONIUM NITRATE RATES FOR ESTABLISHED ORCHARDS GROWN IN SOD



Approximate amounts of 34-0-0 required/year of tree age as the number of trees increase/ hectare (acre).

Reduce rate by 1/2 if orchard is cultivated without sod between tree rows.

From the 7th year on, reduce rates as indicated to prevent over fertilization. Do not exceed 600 Kg/hectare/year regardless of number of trees/ hectare. Take leaf analysis regularly.

For further information, contact your local Horticultural Crop Advisor.

Foliar Application of Nitrogen (N) for Fruit Trees Foliar applications of urea (45% nitrogen) have been used successfully on apples, when weather or crop conditions resulted in a need for additional nitrogen at a critical time. Late applications may adversely affect fruit quality. On apples, use no more than 2.7 kg N per 1000 L (6 kg urea) and apply at least 2000 L/ha starting with the first cover spray, and spacing the sprays about 10 days apart. Do not apply more than three times.

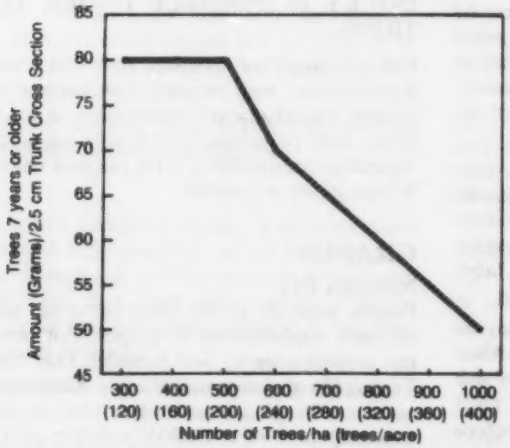
Do not rely on urea sprays to completely substitute for soil applications if nitrogen is required. Under some conditions, low nitrogen levels can lead to poor fruit set and fruit development.

Phosphorous (P)

Phosphorous is not required in large amounts by fruit trees. With few exceptions the level of phosphorous in Ontario soils is adequate at present without additional being required. Phosphorous does have a place for sod or cover crop maintenance. A soil test is the best way to determine if there is a need to apply this nutrient to the sod cover. A complete fertilizer in the absence of a soil test could be applied (100 kg/ha 10-20-20) as a broadcast and incorporated before seeding a cover crop in an orchard. Phosphorous should also be applied before planting an orchard when it can be thoroughly incorporated in the soil if soil test indicates a need.

FIGURE 3.

MURIATE OF POTASH RATES FOR ESTABLISHED ORCHARDS GROWN IN SOD



Approximate 0-0-60 required/2.5 cm trunk diameter/year as the number of trees/hectare (acre) increases.

From the 7th year on, reduce rates as indicated to prevent over fertilization.

Do not exceed 800 Kg of 0-0-60/ha/yr regardless of number of trees/hectare.

Take leaf analysis regularly.

For further information, contact your local Horticultural Crop Advisor.

Potassium (K)
Potassium is important for fruit colour, winter hardiness, tree growth and disease resistance (fireblight in pears). Muriate of potash (0-0-60) is the most common form of potassium. If leaf analysis data is not available the following rates can be considered normal:

TREES 1-6 YEARS OF AGE REGARDLESS OF DENSITY Apply 50 gm K_2O (80 gm muriate of potash) per 2.5 cm of trunk cross-section (diameter).

TREES 7 YEARS OF AGE OR OLDER No more than 3 kg of K_2O (5 kg muriate of potash) should be applied per mature standard apple tree in a year regardless of how severe the deficiency. When fertilizing trees on dwarfing rootstocks, consult Figure 3, "Muriate of Potash Rates for Established Orchards", for approximate rates of muriate of potash to apply at varying tree number per hectare. **When the tree canopy has covered the space available, potassium fertilizer requirements will level out and will not increase indefinitely with tree age.** Again leaf analysis is the most reliable guide.

Placement and Timing Potassium can be applied separately or combined with nitrogen then applied in the early spring. Some orchardists make fall applications because of time constraints in the spring, however, some of the potassium may be lost by leaching over winter. For this reason, spring application is usually recommended. In sod orchards, potash should be applied in a band around the dripline or in the herbicide strip.

An excess amount of potassium (K) can lead to deficiency of magnesium (Mg), so care must be taken when deciding upon potassium rates.

Magnesium (Mg)
Magnesium deficiency is becoming more evident in orchards, particularly when high rates of potash are used.

Magnesium deficiency can lead to premature drop of fruit at harvest, especially with McIntosh. Magnesium deficient trees have older leaves that are pale in colour, as magnesium is a part of the chlorophyll molecule. Leaf analysis is the best way to evaluate Mg needs.

Foliar sprays of magnesium have been effective in correcting this deficiency for the current year. For more permanent correction, soil applications of Mg have been required.

Magnesium foliar sprays will alleviate a deficiency for the current year only. Three sprays should be applied, starting around the calyx period, continuing every two weeks. At least 3.8 kg Mg/ha (40 kg magnesium sulfate-epsom salts) should be applied at each time of application. For dilute application, use 1.9 kg Mg/1000 litres (20 kg magnesium sulfate) with at least 2000 L/ha. Do not exceed 3.8 kg Mg/1000 L.

Fruit or foliage injury is possible from a mixture of pesticides with magnesium sulfate; therefore, magnesium sulfate should be applied separately or tried on a few trees first. Magnesium chelates* should be applied at a rate of .5 kg of magnesium per hectare at each application. Check manufacture's label regarding mixing magnesium chelates* with pesticides.

For long-term corrections soil application of Mg can be made, but the response will not likely be immediate. Also, on some soil types a single early spring application of soil applied Mg has not worked well. A second or third application the following spring may be required before the Mg level in the tree improves. To be sure that fruit drop is not a problem during this waiting period, foliar sprays are recommended for the first two years, in addition to soil application.

For soil corrections, apply 5-7 kg/mature standard tree. and 3-4 kg/mature dwarf tree of Sul-po-Mag. This is a granular fertilizer known by several trade names. It contains approximately 21% potash, and 11% magnesium. This material is applied in early spring in a band under the tree dripline. It contains potassium (K) and rate of application depends on potash needs. No further potash (e.g. 0-0-60) is needed, but apply nitrogen at recommended rates. Other sources of Mg may also work well as a soil application, e.g. Micro-Mate. If Mg is being blended with the fertilizer, at least 80 kg of available Mg should be applied per hectare when the fertilizer is spread. On acidic soils dolomitic limestone can be used to raise the soil pH and to supply Mg.

Calcium (Ca)
Lack of calcium is associated with fruit problems in apple and pear, and gummosis in Italian prunes. In Ontario, Bitter Pit of apple is the most common problem that is associated with calcium. For more information consult the current Factsheet on Bitter Pit. Recent studies wth Ca point to an increased fruit firmness and delay of maturity of apple cultivars, particularly McIntosh, when foliar Ca is applied. This effect of Ca can be a great asset to this cultivar to enhance fruit quality at harvest.

Ca is best applied as a foliar spray. Calcium chelate* should be used for McIntosh. **Calcium chloride is not recommended for McIntosh because of the risk of foliar burning.** Four sprays are recommended starting in mid-July and repeated every 2 weeks. Additional sprays can be applied up to harvest. The more calcium that can be applied, the better the control BUT there is a concentration at which Ca can cause foliar burning. Calcium should be applied at the rate of 3.6 kg/ha in 2000 L water (calcium chloride 5 kg/1000 L or calcium nitrate 9 kg/1000 L) for each application. If the nitrogen level in the leaves is high, calcium chloride is preferred to calcium nitrate. It is a good idea when using calcium chloride to first mix the required calcium in a pail of water to be sure that all the product is dissolved before adding the slurry to the spray tank.

DO NOT CONCENTRATE NUTRIENT SPRAYS OR SPRAY AT TEMPERATURES ABOVE 25°C. FRUIT INJURY IS POSSIBLE UNDER THESE CONDITIONS.

Other sources of calcium (calcium chelates*, or other formulations) may increase fruit Ca and reduce bitter pit. Follow manufacturer's instructions as to rate and compatibility with pesticides. Check with pesticide manufacturers regarding compatibility with calcium chloride, as fruit and foliage injury is possible.

GRAPES

Nitrogen (N)
Petiole analysis is the most accurate way to determine nitrogen requirements of grapes. For information on this test, consult page 63, Soil Samples, Leaf Analysis and Tissue Testing. In the absence of such information, 34 kg N/ha

* *Use chelates recommended for foliar sprays.*

(100 kg 34-0-0 per hectare) is usually sufficient for most cultivars. This nitrogen is best broadcast before the first cultivation or applied as early as possible in the spring in sod vineyards. Nitrogen application can be reduced or eliminated if manure is used or growth has been excessive. For more information on manure, consult Manure for Orchards and Vineyards, page 67. Consult Table 15 for petiole analysis values.

Phosphorous (P)
See notes on Phosphorous, page 69 in Tree Fruit Section.

Potassium (K)
An excess amount of potassium can lead to deficiency of magnesium (Mg), so care must be taken when deciding upon potassium rates. Grapes require a larger quantity of potassium than tree fruits. In the absence of petiole analysis, 400 kg/ha of muriate of potash (0-0-60) every second year on clay soil and 200 kg/ha every year on sandy soil may be adequate.

In cultivated orchards and vineyards potassium may be broadcast before the first cultivation in the spring. With grapes on clay soils it is advantageous to apply potassium in a band to reduce fixation. Potash can cause root and trunk damage if it is applied too close to the trunk.

Magnesium (Mg)
See Notes on magnesium, page 70 for general comments.

For grapes the rate of Epsom salts is 20-30 kg/1000 L of water or 10 L/hectare of magnesium chelate*. Application on grapes should be started in mid-July and 3 applications, 10 days apart should be made.

Calcium (Ca)
Calcium deficiency has been associated with stem and bunch breakdown of Canada Muscat and Himrod grapes.

See Notes on Calcium, page 70 in Tree Fruit section.

MICRONUTRIENTS FOR FRUIT CROPS

Deficiencies of micronutrients or trace elements are not widespread in Ontario fruit plantings. Boron deficiency is perhaps the most common. Deficiencies of zinc, manganese and iron may show up occasionally, particularly in alkaline soils.

The desirable range for micronutrients is quite narrow. More damage is possible with excesses than with deficiencies. For this reason, micronutrients should not be applied to fruit crops except when deficiency is confirmed by leaf analysis or visible symptoms.

Application of only the nutrient that is deficient, in sufficient quantities to correct the problem, is desirable.

Boron (B)
Boron deficiency occurs mainly on alkaline soils or on sandy knolls. Apples are the most sensitive of the fruit crops to boron deficiency. Symptoms include internal breakdown of highly coloured fruit that drops prematurely. A boron concentration in apple leaf tissue in mid-July of less than 20 ppm is considered deficient.

Foliar sprays of soluble boron fertilizers such as "Solubor" should be applied at rates supplying 0.2 kg of available boron/1000 L (1 kg Solubor/1000 L). Two applications 10-14 days apart starting in early June is usually adequate. At least 2000 L/ha should be sprayed at each application if a proven deficiency of boron exists. Other formulations of boron are available. Consult manufacturers' labels for rates and timing. Boron excess may result in a yellowing of leaf edges and midrib, reduced yields, and a shortened life of the fruit.

Manganese (Mn)
Manganese deficiency occurs occasionally in fruit growing areas of Ontario. Its occurrence is closely related to weather conditions, particularly rainfall and soil moisture, as well as soil pH. It is most prevalent in wet seasons or with high soil pH (alkaline conditions).

In mild cases of deficiency, there is a yellowing of the interveinal leaf areas of young leaves near the shoot-tip. Normally, this is not serious. Leaf manganese concentrations below 20 ppm in mid-July are considered deficient. Fruit size, yield, and quality appear to be unaffected. If the condition is severe, spray application of manganese sulfate at the rate of 1.3 kg of available Mn/1000 L (5 kg manganese sulfate) at 2000 L/ha may be used as a corrective measure. Manganese chelates* are also effective in correcting manganese deficiency. Consult manufacturer's label for complete information on rates and timing.

On Red Delicious apples and some peach cultivars manganese toxicity can occur on coarse-textured soils when the soil is very acid (pH below 5.0). The symptoms known as "measles" are raised pimples on the bark underlain by dark brown spots. Other symptoms that may be observed are leaf chlorosis, tip dieback, early leaf abscission, reduced flower bud development and shoot growth. Correction is sometimes possible by addition of lime to raise the pH. If possible, it should be worked into the soil. Soil sampling and addition of lime if pH is low is recommended prior to orchard planting.

Iron (Fe)
Iron deficiency, commonly termed lime-induced chlorosis, is not widespread in Ontario orchards. Occasionally, one or two trees in an orchard may exhibit iron-deficiency symptoms. Often these trees are located near the site of previous lime or building plaster storage, etc., where the soil pH is abnormally high.

Iron deficiency causes interveinal chlorosis of new leaves. As the condition becomes more severe, the whole leaf becomes pale yellow. Quite often only one side or one branch of the tree is affected. Iron deficiency of blueberries is common and is dealt with in the Blueberry fertilizer section, page 65.

Iron chelates* have made correction of iron deficiency relatively easy. These materials can be applied safely as foliar sprays. Consult manufacturer's label for information on rates and timing.

Zinc (Zn)
Zinc deficiency has been identified in some apple orchards in eastern Ontario. The symptoms of this deficiency are short internodes, small narrow leaves, interveinal chlorosis with shoot and branch dieback. In advanced stages, small, narrow terminal leaves are arranged in whorls or "rosettes",

**Use chelates recommended for foliar sprays.*

giving rise to the typical "rosette" and "little leaf" descriptions for zinc deficiency. Except in severe cases, only a few shoots on an otherwise normal tree will show symptoms. Leaf Zn levels below 15 ppm indicate a deficiency.

Zinc sulfate supplying 3.6 kg of Zn/1000 L as a dormant spray in early spring is effective.

Dilute sprays in June of zinc sulfate or chelate* containing 0.35 kg Zn/ha (1 kg 36% $ZnSO_4$ or 5 L 6.5% Zn chelate*) are effective in correcting zinc deficiency on fruit trees. A fungicide for disease control that contains zinc can be an asset in orchards that are continually low in zinc. Consult manufacturers' labels for zinc concentrations in the formulation.

WARNING: DO NOT CONCENTRATE NUTRIENT SPRAYS.

SOD COVERS FOR ORCHARDS AND VINEYARDS

One of the best ways of supplying organic matter, controlling erosion, and reducing late season growth, is the use of a cover crop. There are two approaches to cover crops: one is temporary; the other is permanent.

A temporary cover crop is seeded late in the season. Cultivation should be stopped by July 1 in orchards and cane fruit plantings and by August 1 in vineyards. A cover crop such as Italian rye grass can then be seeded at the rate of 13 to 17 kg/ha. Use soil tests to determine optimum fertilizer rates or fertilize with 100 kg/ha 10-20-20 before seeding to promote growth and organic matter production.

For permanent sod covers there are many different species of grass that can be used. The grass chosen should not be overly vigorous, and should be resistant to traffic damage in early spring and late fall. It should be drought resistant and be discouraging as a habitant for voles (field mice). Tall fescue or creeping red fescue make excellent sods and also offer some suppression of nematodes. To aid germination, they should be seeded as shallow as possible at the rate of 20 to 22 kg/ha in late August or September. The soil needs to be well prepared and fertilized according to soil test results or with 100 kg/ha 10-20-20 before seeding. Sod mixtures containing grasses and legumes can also be used, but inclusion of legumes may result in the untimely release of nitrogen.

WEED CONTROL

Detailed recommendations for the control of weeds in fruit crops are included in Ontario Ministry of Agriculture and Food Publication 75, *1992 Guide to Weed Control.* For information on chemicals, cultural weed control practices, safety precautions, and calibration and care of weed sprayers, refer to Publication 75.

Many horticulture crops can be damaged by certain commonly used herbicides. Sprayers that have been used for hormone-type (2,4-D type) chemicals SHOULD NOT BE USED for applying insecticides or fungicides on horticulture crops.

**Use chelates recommended for foliar sprays.*

All herbicide rates given in Publication 75 refer to the area of soil actually treated with the chemical. Read the instructions thoroughly and do your mathematical calculations and measurements carefully.

The weed control program on soil that will be used for other crops in the near future may require the substitution of other herbicides which do not leave long-lasting residues in the soil. Plan at least 2 years ahead.

PROMALIN TO IMPROVE FRUIT SHAPE OF DELICIOUS

Promalin (Abbott Laboratories, North Chicago, Ill.) is registered for use on Delicious strains in Ontario to improve the appearance of the fruit (elongation and more prominent calyx lobes). Careful timing of the application, close adherence to recommended label rates, and complete coverage are essential to satisfactory results.

Application of higher rates or volumes per hectare than those recommended on the label may result in undesirable fruit thinning. Concentrate applications are not recommended at this time. For optimum results the application should be made between the king bloom balloon stage and full bloom. Applications earlier or later than this recommended interval are likely to produce an unsatisfactory response.

Strains of Delicious seem to respond equally to Promalin application. The response will appear to be better on the naturally more-typey strains. Postbloom weather has a strong influence on the development of typiness and will affect the response to Promalin as well. Growers interested in using Promalin should familiarize themselves with the material through carefully applied trial applications to small blocks, leaving some trees untreated for comparison.

THINNING OF TREE FRUITS

Chemical Thinning of Apples

Thinning of apples is often required to improve fruit size, create more uniformity in fruit size and to control the alternate bearing habit of some cultivars. Thinning needs must be based on grower experience, taking into account the cultivars involved, the amount of bloom, bee activity, weather conditions during pollination, and previous thinning history of the orchard.

Chemicals Available for Thinning

NAD (Naphthaleneacetamide), such as AMID THIN is a hormone-type material that is foliarly absorbed where it induces formation of the abscission layer between spur and fruit. This is a relatively safe material applied at petal fall at a concentration of 50 to 100 ppm, depending upon cultivar and growing conditions. This hormone-type material is mostly absorbed from the original solution. Once dry, the effect it has on thinning is over. At least 1000 litres of water/hectare is preferred in standard-size trees for satisfactory uptake. Weather that promotes soft, succulent and rapid growth will lead to increased absorption. Avoid windy, cool, fast drying conditions. Temperatures between 21°C - 24°C are considered optimum.

NAA (Naphthaleneacetic acid), such as NIAGARA-STIK, STAFAST, FRUITONE-N, BARTLETT-STIK, is a hormone-type thinner that is absorbed through the leaves. It works as a growth regulator affecting auxin activity and interfering with proper fruit development. The fruit being

thinned usually drops within 10-14 days after spraying. NAA needs to be dissolved in water in order to be absorbed by the foliage. Almost all NAA is absorbed from the original solution. Once dry, the thinning effect is stopped. Thus, larger volumes of water under slow drying conditions are recommended when applying NAA. At least 1000 litres of water/hectare is preferred in standard-size trees for satisfactory uptake. The longer the time required to dry the spray and the higher the drying temperatures, the greater the absorption of the NAA. NAA also has a short life due to breakdown by sunlight. The most effective time to apply would be under warm, dull, slow drying conditions. The preferred time is in the morning when the trees are damp, drying is slow and the temperature is on the rise. The material is absorbed and the tree has an immediate growing day to utilize the thinner.

Carbaryl (Sevin) In the early 60's, the insecticide "Sevin" was discovered to have fruit thinning properties. Sevin is absorbed primarily through the fruit, not the foliage. The presence of Sevin in the vascular system of the fruit interferes with biochemical processes. Certain important fruit growth processes cease, and the fruit drops. This fruit drop is usually completed from 5 to 10 days after application. Thinning with Sevin increases regularly with concentrations up to 0.75 kg (Active)/1000 L of water but there may be little or no increase in thinning with higher concentrations. Sevin is relatively insoluble in water and low concentrations produce a saturated solution. This is a limiting factor in its effectiveness because absorption by the fruit is limited to materials in true solution. It is an advantage however, in that the hazard of over thinning through error in concentration is reduced. Sevin does not appear to require as much water to be effective as NAA or NAD. Sevin can be applied by concentrate spraying and still work effectively. There also appears to be additional absorption from rewetting, unlike the hormone-type thinners. Sevin, although the easiest and safest thinner to use, is harsh on beneficial insects. Alternate choices for thinning are recommended if an IPM Program is to be maintained.

Carbaryl (Sevin) plus NAA Sevin plus NAA has been used on hard-to-thin cultivars such as Early McIntosh, Golden Delicious and Wealthy with considerable success. A constant rate of Sevin of 0.5 kg (active)/1000 L of water should be used with varying rates of NAA from 3 to 15 ppm. Because NAA only has one chance to work, a higher water volume than that normally used for Sevin is recommended.

Use of a Surfactant
The use of a non-ionic spreader sticker, eg. Agral 90, will increase absorption of NAD and NAA. This can be useful under adverse weather conditions for thinning, eg. hot and dry, or where certain cultivars have proven hard to thin even with high rates of NAA or NAD.

Factors Influencing Response to Thinning Agents

1. Cultivar Sensitivity
   (a) Easy-to-thin cultivars include Red Delicious, Idared, Spy, and Crispin (Mutsu).
   (b) Hard-to-thin cultivars include Lodi, Duchess, Golden Delicious, Early McIntosh, Wealthy and Paulared.
   (c) Non-spur strains are easier to thin than spur strains.
2. Certain weather conditions may increase thinning response by permitting greater absorption of chemicals:
   (a) Cool, wet weather before or after application.
   (b) Prolonged period of high humidity without rain, either before or after application.
   (c) High temperatures following cool periods.
   (d) Frost or near-freezing temperatures before or shortly after application.
   (e) A prolonged period of dry weather before application.
3. Pollination and Bee Activity
   These are tied in closely with weather conditions. Pollinating conditions and bee population may render trees either more or less difficult to thin. Fruit that is set under good pollinating conditions and results in increased seed count is harder to thin. Fruit that is set on king blossoms is more difficult to thin than fruit set from side blossoms. Single fruit are more difficult to thin than clustered fruit. A light or spotty set with clustered fruit should be thinned but at low rates, in order to break up clusters.
4. Tree Age and Vigour
   (a) Young trees are more easily thinned than mature trees.
   (b) Mature trees that are low in vigour, for whatever reason, are more easily thinned.
   (c) Trees bearing a heavy crop one year and having good bloom the following year may be more easily thinned.
   (d) The heavier the bloom the more stress on the tree and the easier to thin.
   (e) The more stress from the previous season, e.g. excessively dry, nutritional deficiencies, insects or disease, then the easier to thin.
5. Pruning
   (a) Poorly-pruned dense trees may be thinned more easily than well-pruned open trees.
   (b) Low, partially-shaded branches of well-pruned trees may be thinned more easily than upper branches.

Timing of Application
Application timing varies with the chemical used. NAD is applied during petal fall. The best timing for application of NAA, Sevin and NAA + Sevin combinations is 7-12 days after petal fall[1] (early cultivars are an exception, see Suggested Rates Table). Seven days if it is warm and 12 days if it is cool. NAA is only effective as a thinner if applied up to 12 days after petal fall. Sevin can be effective as a thinner when applied up to 21 days after petal fall. NAA applied too soon can result in excessive thinning. NAA applied to late can result in reduced fruit size and in severe circumstances, pygmy fruit. Sevin applied too soon does not work as well.

[1]*Petal fall = when most petals have fallen off but before calyx lobes are closed.*

For three major cultivars, McIntosh, Red Delicious and Spy, a size relationship for applying chemical thinners based on average fruit diameter has been worked out. This relationship works best when size of all the fruit to be thinned is fairly uniform.

Cultivar	Diameter at NAA-sensitive Stage
McIntosh	8.0-9.5 mm
Red Delicious	6.5-8.0 mm
Spy	10.0-11.0 mm

Sampling Method

A total of 50 to 60 fruits of each cultivar should provide a good estimate of fruit development in a reasonably uniform orchard block. Select the two largest developing fruits from each of 25 to 30 randomly selected clusters, measure the greatest width of each and determine the sample average. Vernier calipers or fruit-sizing rings provide a simple means for taking measurements rapidly and accurately.

The Steps in Thinning

The first step in thinning is to determine how much thinning is required. This is done by looking at the orchard factors and assessing fruit load potential. Sepals (calyx leaves) on unpollinated fruit have a tendency to open up or bend back. On pollinated fruit the sepals will close over. Then determine the material to use and the concentration or strength of the thinner required. Then determine the water volume that is required to effectively deliver the thinner to the tree. In single row orchards as the tree size becomes smaller and the number of trees per hectare increases, the volume of canopy that must be sprayed becomes less and less. The volume of water required to effectively deliver the thinner becomes less as well. Use of Tree Row Volume (TRV) concept of calculating water volumes is the most accurate way to make this adjustment.

Suggested Rates for Chemical Thinning of Apples

The rates below are suggested guidelines only. There is no substitute for personal experience. It is important that yearly records be kept on weather conditions, rates, etc., and above all, that some trees be left unsprayed to help assess the thinning response. Use only one of the suggested chemical treatments. For example, with Wealthy, apply NAD or NAA or the combination.

	USE ONLY ONE OF			
Cultivar	NAD ppm	NAA ppm	Sevin 50% WP (carbaryl)* kg/1000 L	Combination Sevin 50% WP (carbaryl)* + NAA
Lodi, Melba, Quinte, Transparent	50-75	—	—	1.0 kg carbaryl + 5-10 ppm NAA in 1000 L (at petal fall)
Early McIntosh	75-100	—	—	1.0 kg carbaryl + 5-10 ppm NAA in 1000 L (at petal fall)
Jerseymac, Vista Bella Tydeman's Red	—	5-10	1.0-1.5	
Paulared	50-75	10-15	1.0-1.5	1.0 kg carbaryl + 10-15 ppm NAA in 1000 L
McIntosh, Spartan Cortland, Russets	—	10-20	1.0-2.0	1.0 kg carbaryl + 4-8 ppm NAA in 1000 L
Golden Delicious Wealthy	75-100	10-20	1.0-2.0	1.0 kg carbaryl + 5-10 ppm NAA in 1000 L
Red Delicious	—	2-8	0.5-1.5	
Idared	—	2-8	0.5-1.0	
Empire	—	7-10	1.0-1.5	1.0 kg carbaryl + 2.5-4 ppm NAA in 1000 L
Spy, Crispin (Mutsu)	—	5-10	0.5-1.5	

** Actual amount of product, dilute spray basis. 1 kg Sevin 50% WP contains 0.5 kg active Sevin (carbaryl).*

Calculating Parts per Million (ppm)
1 ppm = 1 g active ingredient per 1000 L water

Defruiting immature apple trees to encourage proper development is highly desirable. Experimentation to date indicates NAA 15 ppm plus Sevin 50 WP 2 kg per hectare five days after petal fall as giving best results.

Bee warning

When Sevin is used in fruit thinning, extensive bee kills can occur if the orchard cover carries a heavy bloom of dandelions or other weed blooms. To avoid such toxicity, keep the dandelions mowed and remove bees from the orchard prior to treatment. Do not spray when the wind will carry Sevin to adjacent weed areas. Advise local beekeepers of your spraying activity. Your local Agricultural Representative has a list of beekeepers in your area.

PEACH THINNING

Peach fruit thinning is essential for good orchard management and is necessary to obtain fruit of good size and quality.

Most peach varieties have the potential for over cropping which results in limb breakage, reduced fruit size and quality, loss of tree vigour, shortened orchard life and increased pest management problems. Optimum fruit density depends on variety, tree vigour, orchard management procedures (tree density, irrigation, etc.), tree age and tree health (winter injury, canker, etc.).

Often fruit spacing receives more attention than fruit density. Orchardists tend to think of spacing the fruit 15 to 20 cm apart (one to three fruits per shoot). Distance between fruit is not too critical as long as clusters are broken up and fruits are separated. Tree crop load (kg/tree or number of fruits/tree) is a more important consideration. As an example, to obtain a yield of 16 to 24 tonnes/hectare (8-12 tons/acre) in an orchard with a tree density of 490 trees/hectare (200 trees/acre) requires about 200 to 300 fruits per tree assuming an average fruit size of 5.5-7 fruits/kg (2.5-3 fruits/lb). With current emphasis on increased fruit size for better marketability and trends towards higher tree densities, fruit densities of 175 to 200 fruits per tree may be more ideal, at least for larger-fruited varieties.

Pruning, as described in OMAF Publication 392, is an essential part of the fruit thinning procedure. A considerable amount of the excess crop is removed with careful pruning, but normally fruit thinning must follow to avoid over cropping. Thinning at blossom time or at early fruit development has more benefits than late thinning. However, it is difficult to get a true assessment of crop load before June drop has occurred. Furthermore, early ripening cultivars, such as Earlired and Candor, frequently bear a fairly high percentage of fruit having split-pits. Growers often delay thinning these cultivars until many of the split-pit fruits can be identified and selectively removed.

Three methods available are:

(1) hand with or without mechanical aids

(2) mechanical

(3) chemical

HAND

Thinning by hand is most commonly accomplished with manual labour. Mechanical aids such as a child's plastic bat, a rubber hose mounted on a bamboo pole or broom handle, or plastic rake manufactured for this purpose are useful to break up clusters. There is little likelihood of over-thinning early cultivars when the set is heavy. Late-maturing cultivars are thinned according to their individual requirements. Heavy-setting, hard-to-size cultivars such as Redhaven and Madison require heavier thinning than easier-to-size types like Vivid and Loring. As a rule of thumb, however, late-maturing cultivars with a good, uniform set are usually thinned 10 to 13 cm apart. Distance between fruits is not too critical as long as clusters are broken up and fruits separated. If the set is spotty on the tree, more fruits may be left on heavy-set branches. Initial thinning often is followed up by a "touch-up" thinning to assure that fruit numbers per tree conform to conditions and standards set for the variety and the orchard.

MECHANICAL

The trunk-shaker method supplemented by touch-up hand thinning has been tried by a few growers. Major drawbacks of this method are erratic thinning and the danger of over-thinning. Stiff branches are easily over-thinned, while willowy or hanging branches are generally under-thinned. A mechanical trunk shaker reduces thinning costs, but the savings often are more than obliterated by losses in yield due to over-thinning. If mechanical thinning must be practised, an observer must accompany the machine operator to help avoid over-thinning. It will be necessary to leave more fruit than normal on some of the under-thinned branches to compensate for excessive thinning on others. Mechanical pruning of peaches is not recommended.

CHEMICAL

There is no truly satisfactory chemical available. Dinitro materials such as Elgetol applied during full bloom may provide satisfactory results in the Niagara peninsula. Dinitro should not be used in areas and seasons where the risk of late spring frost is high. In orchards where a dinitro can be used safely, it should be applied when 90 to 95% of the blossoms are open. It is preferable to spray a little early rather than after blossoms have been open for some time. Elgetol, for example, may be used at 0.5 to 1.7 litres per 455 litres of water (1 to 3 pints per 100 gal), depending on cultivar. Trees under 5 years of age should not be chemically thinned.

Pear

The major pear cultivars grown in Ontario benefit from fruit thinning. The thinning of fruit will be particularly necessary during seasons of heavy fruit set or inadequate moisture. Bartlett and Bosc set fruit in clusters of 3 to 5 fruits per spur. If fruit set as a whole is excessive, reduce these clusters, preferably to 1 or 2 fruits each; if the set on the tree is not excessive, fruits on these clusters will reach a satisfactory size without implementation of fruit thinning.

Response of Pears to Chemical agents, under Ontario conditions, is inconsistent from year to year. Growers should try chemical thinning on a small scale until they have evaluated response in relation to tree vigour, cultivar and fruit size desired and obtained.

Growers wishing to try chemical thinning of pears will obtain the best results using either NAA (NAPHTHALENEACITIC ACID) or NAD – (NAPHTHALENEACETAMIDE). The suggested rates are NAA at a concentration of 15 - 20 ppm approximately 3 - 6 days after petal fall or NAD at 10 ppm 6 - 9 days after petal fall, depending on tree vigour and amount of thinning desired.

Plum

In normal years, Japanese plums require systematic fruit thinning; otherwise fruit size will be small and a biennial cropping will ensue. European plums grown for fresh market

also require thinning in the years of heavy fruit set. Inadequate or lack of fruit thinning will result in production of small size and, at times, timely fruit ripening on overloaded trees will be delayed.

By hand thinning, flowers or fruits are simply pulled or broken with the fingers. Fruit size thinning is preferred to conventional space thinning. Size thinning is selectively removing small, weak, blemished or diseased fruits regardless of spacing of the fruits on the branches. The end result should be proper sizing of the fruit remaining on the tree.

Chemical thinning with plums is notoriously variable and uncertain under the growing conditions in Ontario. Dinitro, at the rate and conditions stipulated for peaches, could be tried. Also Elgetol at 1.25 L per 1000 L of water might be beneficial to attain some degree of blossom thinning with this crop. However, chemical thinning should be used on a limited scale until growers have evaluated response in relation to tree vigour, cultivars, and fruit size desired and obtained.

ETHEPHON TO PROMOTE FRUIT COLOURING AND ADVANCING APPLE MATURITY

Ethephon (Ethrel) has the following effects on trees and fruit, depending upon the time and rate of applications:

1. Ethrel stimulates ripening, colour development and fruit drop. The fruit may all be on the ground one week after spraying unless a suitable stop-drop is used. Two applications of naphthaleneacetic acid (NAA) are required: one as a tank mix at the time Ethrel is applied and the second five days later. Apply the stop-drop at the normal rate recommended on the label.
2. **Spray just the number of trees that can be harvested over a two or three day period.** Following the spray application the fruit will be ready to harvest within five to ten days, depending on cultivar. After spraying, check the maturity of the apples on a daily basis (e.g. pressure, starch, flavour, colour). A few trees sprayed at three to four day intervals would be easier to manage than a large number sprayed at one time. **A market should be available for the treated apples before they are sprayed, especially with early cultivars.**
3. Rates of application depend upon the cultivar, date of application, tree vigour, temperature, weather conditions and degree of response required. The response to Ethrel is a chemical reaction and as such is dependent upon temperature. For this reason early cultivars such as Red Melba and Early McIntosh require less material than later cultivars. On early cultivars such as Red Melba and Early McIntosh, use 0.75 to 1.5 L of Ethrel per hectare applied with sufficient water to wet the trees thoroughly. McIntosh requires 1.5 to 4.25 L/ha. The higher rate is used early in the season on trees that are high in nitrogen, or on trees that are poorly pruned. Lower rates may be advantageous nearer the normal harvest, on young, well-pruned trees, or on trees that are low in nitrogen.
4. Best results are obtained when Ethrel is applied 2-3 weeks before you would normally begin harvesting. Be sure and apply Ethrel uniformly, since it will work only where the spray touches.

CHEMICAL CONTROL OF PREHARVEST DROP OF APPLES

Cultivars differ in their tendency toward preharvest drop. In this respect, McIntosh gives the greatest concern in Ontario.

Fruit drop tends to be greater with trees in which the nitrogen content is high during the late summer and with trees carrying a heavy crop. Hot days and warm nights just before and during harvest tend to increase the amount of preharvest drop.

Drop may also increase if trees are deficient in moisture or the nutrients boron or magnesium. Trees heavily infested with spotted tentiform leafminer also have a greater tendency for pre-harvest drop.

NAA (naphthaleneacetic acid), such as NIAGARA-STIK, STAFAST, FRUITONE-N, BARTLETT-STIK, is the only chemical registered to control drop on apples. This is the same material that is used earlier in the season for thinning the crop. The concentrations differ for the two purposes. NAA is effective for 7 to 10 days after spraying. Longer holding can be obtained by repeated application of single strength every 7 days. It takes 1-2 days for NAA to take effect after application. Apply NAA as soon as the first sound apples begin to drop, at the rate of 10 ppm (single strength application). Do not confuse the normal preharvest drop of sound apples with those that have been pushed off, or are dropping because of insect, disease or nutritional deficiency.

NAA is preferably applied in a dilute spray. A dilute application favours more uniform coverage which is important because NAA is only locally systemic and high amounts of water slows drying rates for increased absorption. The optimum temperatures for maximum absorption are at or near 21-24°C (70-75°F) and high humidity. Absorption is less on foliage injured by insects, diseases or frost and at temperatures below 16°C (60°F). The addition of a non-ionic type spreader sticker, eg Agral 90, will improve absorption of NAA under less than ideal weather conditions.

NAA can advance ripening of the fruit. The higher the concentration used and the greater the number of applications, the greater will be the ripening effect. One application of single strength (10 ppm) will have little effect on direct ripening, however, it is recommended that apples, particularly McIntosh, should not be stored long term (late opening CA or long-term cold) if they have been treated with NAA. Apples from trees that were treated a second time with NAA should be marketed immediately.

RODENT AND DEER CONTROL IN ORCHARDS

Control of rodents and deer is most effective when it is part of a season-long management strategy involving good sanitation, cultural and chemical control methods. A complete description of pest biology and control tactics is available in OMAF Factsheet, *Rodent and Deer Control in Orchards*, Agdex 210/681.

For Mouse and Vole control the following baits are available:

1. Zinc-Phosphide-treated baits — Several products are available. Generally the rates of application are between 5.5 to 11 kg/hectare, depending on the severity of

infestation. If further mouse activity is detected, repeat the treatment when rain is not expected.

2. Diphacinone (Ramik Brown) — 22 kg/hectare in two applications of 11 kg each. Applications can be made 20 to 40 days apart.
3. Chlorophacinone (Rozol, KsC^2) — 11 kg/hectare. Repeat in 20 to 60 days where infestation is high.

WRAPPING YOUNG TREES

Wrap sacking about the top and the trunk above the mouse guard to protect young trees from rabbits. Tie the wrapped tree securely to a strong stake or steel fence post to prevent snow and ice breaking the tree over. Mouse guards generally do not give protection against rabbits when the snow is deep.

REPELLENTS

a) Taste – Rabbits are discouraged from feeding on the trunks of young trees if the trunks have been treated recently with thiram. Thiram is mixed with diluted, exterior latex white paint and applied to the trunks each Fall.

For more information refer to the following section on the control of South West Injury and to the factsheet noted above.

b) Scent – Fruit trees bushes and plants treated with Hinder can be less susceptible to brousing injury from deer and rabbits. The active ingredient of Hinder is Ammonia soaps of the higher fatty acids.

Retreatment may be necessary after heavy rainfall. Hinder is reported to be more effective when used during warm temperatures.

Hinder may be applied to the following food crop plants up to 14 days before harvest.

For apples, blueberries, cherries, peaches, pears, plums, and raspberries, apply 3-5 litres of product/100 litres of water.

For strawberries, apply 2-4 litres product in 100 litres of water. Apply 450-950 litres of spray solution per hectare.

REPAIRING DAMAGE BY MICE AND RABBITS

Regular inspection should be carried out throughout the winter to see if any injury has occured. Mice often work just below the surface of the snow or in the litter. If a tree has been wholly or partially girdled, it should be given first aid immediately. Cover the wound with a grafting compound or a wound dressing.

Before the buds swell in the spring, secure enough long scions to bridge the wound. See OMAF Factsheet, *Repair Grafting*, Agdex 210/24. Store the scions in damp sand or sawdust in a cool place. If the wound extends for more than one quarter of the circumference of the trunk, bridge graft in the manner described in OMAF Factsheet, *Repair Grafting*. Grafting should be done when the bark slips readily from the wood (about bloom). Repair grafting is not practical on trees with a diameter less than 10 cm. Small trees should be replaced.

BIRD DAMAGE AND ITS PREVENTION IN ORCHARDS AND VINEYARDS

Every year, birds destroy large quantities of fruit in Ontario. Cherries, grapes and blueberries are crops most subject to attack, but other fruit crops may also be damaged. Losses of 25% for sweet cherry and 10% for grape crops are not uncommon, although the extent of fruit damage varies greatly among varieties, location and seasons. Pecking and puncturing damage is usually greater than actual losses from fruit consumed.

Several bird species are responsible for damage to ripening fruit crops. Among the most destructive are robins, starlings, grackles and orioles. A report published by the Canadian Wildlife Service identified adult robins and grackles as the main culprits damaging early ripening sweet cherries; starlings and, to a less extent, juvenile robins cause most of the damage to later ripening cherries. Grapes are taken mainly by robins, but flocks of starlings do cause periodic damage. Migrating Baltimore orioles reportedly limit their attack mainly to early grapes ripening during late August.

Birds show definite preference among fruit varieties. The Wildlife Service Report implicated fruit color differences as the explanation for this varietal preference. Robins, grackles and starlings commonly select the reddest cherries or darkest grapes available. Early black sweet cherries and grapes are, therefore, particularly susceptible to bird damage. Small-berried, early blue grapes such as Leon Millot and Marechal Foch are often stripped rather than pecked.

Methods of Control

Discussion herein of certain drastic control measures does not imply their universal recommendation. In all cases, local, provincial and federal laws governing killing of birds, or the use of sound-scaring devices, must be followed.

Location The location in which commercial fruit crops are planted can be an important factor in the control of birds. Cherry orchards planted near a wooded area are particularly susceptible to damage, as birds find shelter and nesting sites close by. Similarly, small fruit plantings near hedges are particularly vulnerable.

Physical Protection The only completely foolproof method of control is to cover plants with netting, thereby physically preventing birds from getting at the fruit. This method may be economically feasible for some grapes and highbush blueberries but would seem impractical for tree fruits.

Shooting Shooting starlings and grackles is still a very practical control method. Normally shooting does not materially reduce the bird population, but serves primarily as a technique to frighten them out of the orchard. Robins and Baltimore orioles are protected by an act of parliament, but special permits may be obtained to kill them when they are shown to be causing damage. Shells are also available with delayed explosions and/or sustained whistles which disorient and frighten the birds.

Automatic Exploders One of the most commonly used bird controls is the automatic exploder. This is a propane-powered cannon set to produce a loud gunshot-like sound at specified intervals. Many birds soon become accustomed to these cannons and are sometimes observed perched fearlessly near the device while they explode. Automatic

exploders are particularly effective when used in conjunction with shooting.

Next to shooting, these noise-producing devices are the most effective method that is presently commercially available for control. However, the element of surprise and uncertainty plays a big part in disrupting the birds. Regular movement of the devices to different locations in the orchard or vineyard is very important. Birds quickly adjust their feeding habits if the scaring device is left in the same location throughout the harvest season.

A major drawback of these devices is the disruption of the surrounding neighbours' quality of life. Growers must recognize this fact and adjust the use of this equipment to cause the least discomfort to those around them.

Av-Alarms The Av-Alarm sends out an electronic sound which apparently deafens birds temporarily, causing them to move out of an orchard after one or two days of exposure. The Av-Alarm has been effective in reducing bird damage to sweet and sour cherries, grapes and other fruit crops.

Chemical Controls At the time of writing, **THERE ARE NO CHEMICALS REGISTERED FOR USE IN ONTARIO FOR THE CONTROL OF BIRDS IN FRUIT CROPS. IT IS ILLEGAL TO USE UNREGISTERED CHEMICALS ON ANY FOOD CROPS.**

Other Methods Other control methods which have been tried include broadcast distress and alarm calls, aluminum foil hung in trees, model hawks, strips of yellow plastic hung across vineyards, vibrating plastic strip, scarecrows with power-driven moving arms, trapping and various noisemakers. These have met with only limited success.

CONTROL OF SOUTHWEST INJURY ON FRUIT TREES

Southwest injury (winter sunscald) occurs during the winter and is especially severe when cold sunny days are followed by cold, clear nights. Injuries are usually confined to the south and southwest sides of the trunks and main scaffold branches. On sunny days these tissues become considerably warmer than the surrounding air and at night they cool rapidly; freezing of the bark may occur. Freezing injury usually affects large portions of the bark tissue which becomes brown and will eventually slough off as healing occurs beneath. In stone fruit orchards, these injuries provide ideal sites for infection by the peach canker or other canker diseases. The combined effect of southwest injury and peach canker greatly reduces the productive life of affected trees.

Southwest injury can be prevented and peach canker reduced by painting the trunk, crotches, and lower parts of main scaffold branches with exterior white latex paint. OIL-BASED PAINTS SHOULD NOT BE USED. They contain toxic materials which may injure or kill fruit trees. Latex paints which contain some oil should not be used either. The white paint reflects sunlight and prevents the tissues exposed to direct sunshine from rapid thawing on cold days when air temperatures are below freezing. Rapid thawing in the day and freezing at night are prevented by the paint and thereby reduce freezing injury.

October is the best time to apply the paint. Best results are obtained when trees are painted on days when the temperature is above 10°C and conditions favour rapid drying. The paint may be applied by brush or by spray. On young trees, the whole trunk should be painted; but on older trees only the south and southwest sides of the tree require painting. The whiter the bark after painting, the greater the protection.

On young trees, one to three years old, **injury from rodents may be a greater problem** than southwest injury. To obtain protection from both problems, thiram (75% white WP) should be incorporated into the paint*. Thiram acts as a taste repellent for rodents and helps to prevent infection by peach canker. **Mix 400 g of thiram with 2 litres of water and stir slowly into 4 litres of paint.** This mixture may also be used effectively as a wound dressing. On older trees where rodent damage is less of a problem, the thiram can be left out and the diluted paint used by itself. One or two litres of water per 4.5 litres of paint may be necessary if the material is applied by spray, depending on the thickness of the paint and the air pressure available.

Note that the thiram-latex mixture should not be used if a fall bordeaux spray program is planned. The thiram reacts with the bordeaux spray, changing the colour of the paint from white to brown, and reducing its effectiveness as a heat reflectant. The bordeaux spray does not affect trees painted with latex only and can be used when thiram is excluded from the mixture. If the thiram-latex mixture is planned as a combined rodent repellent and protectant from southwest injury, then the whole trunk must be painted and good coverage at the soil line is very important to prevent mouse damage.

**A number of commercial pre-mixtures are also available.*

NEMATODES

Root-lesion nematode damage on **strawberries** usually consists of a discoloration of the fine feeder roots and tiny, brown, scratch-like lesions on the young adventitious roots. These lesions merge to form large brown areas on the roots. There is also evidence that root-lesion nematodes are involved in the black root-rot complex and that they aggravate verticillium wilt of strawberries.

Root-lesion nematode damage on **raspberries** results in the same scratch-like lesions as described above for strawberries and fruit trees. In addition, the canes are thinner than normal and fewer canes are produced per crown; cane height is not usually reduced. Up to 25% of the first year canes may be killed in severe infestations of these nematodes.

TABLE 16. CONTROL OF NEMATODES AND RELATED PROBLEMS IN STRAWBERRY AND RASPBERRY PLANTINGS IN MINERAL SOILS

To control	Material	Broadcast (L/ha)
Nematodes only	Telone IIB	170
	Vorlex Plus	55-130
	Vorlex Plus CP	55-220
Verticillium and nematodes	Telone C-17-R	200-380
	Vapam†	470-900
	Vorlex Plus	225-450
	Vorlex Plus CP	220-440

†Vapam is applied by shank injection or in irrigation water – i.e. chemigation. For the chemigation rate refer to the label.

TABLE 17. CONTROL OF NEMATODES AND RELATED PROBLEMS IN ORCHARDS ON MINERAL SOILS

To Control	Material	Broadcast (L/ha)*
nematodes	Telone IIB	200
nematodes	Vorlex Plus	55-130
nematodes	Vorlex Plus CP	55-220
nematodes, diseases	Telone C-17-R	280
nematodes, weeds, diseases	Vapam**	470-900
nematodes, weeds, diseases	Vorlex Plus	225-450
nematodes, weeds, diseases	Vorlex Plus CP	220-440

** Use higher rates for heavier soils, e.g. clay loams.*
*** Vapam is applied by shank injection or in irrigation water – i.e. chemigation. For the chemigation rate refer to the label.*

Root-lesion nematodes can be a major cause of orchard replant failures. They can also cause a decline in vigour of existing peach and cherry orchards. These nematodes kill the fine feeder roots and cause small brown lesions on the white lateral roots. These lesions can merge and discolour the entire root system. Severely affected trees may not have any feeder roots and if the tree is a replant it usually dies. The most striking aboveground indication of nematode damage in an orchard is a general lack of uniformity of trees.

Preplant soil fumigation is the most effective method of controlling nematode problems and is practical when planting a new orchard or when replanting an orchard on an old tree site. Custom operators can do either broadcast fumigation or tree-row. Tree-row application (treating a 2.0-2.5 metre strip centered on the row) is more economical.

Areas that harbour potential nematode problems should be treated before planting. For details concerning nematode problems and preplant soil fumigation, consult your Horticultural Crop Advisor. OMAF Factsheet available is: *Soil and Root Sampling for Nematode Analysis,* Agdex 628.

CAUTION — Telone, Vapam and Vorlex are toxic to the applicator (see reference to Acute and Chronic Toxicity, page 5). Follow instructions regarding proper procedures for handling and application.

Always follow manufacturer's directions carefully concerning dosage and methods of use. Preplant fumigation is most effective when:

1. It is done in the fall when soil temperatures are above 4°C. Warmer temperatures (15°C and over) are preferred for more rapid fumigant dispersal in the soil.
2. Trash and old root systems are removed; the soil worked to a depth of 25 to 30 cm and in good seedbed condition with regard to tilth and moisture.
3. The fumigant is injected about 20 cm deep.
4. The soil surface is sealed by packing or watering immediately after injection of the fumigant.
5. The soil is left undisturbed until spring or, in the case of fall planting, at least one week after injection of the fumigant. Colder soils (below 15°C) require longer periods from injection to aeration.
6. The soil is worked and aerated for about a week before planting. For fall planting, the soil should be aerated at least two weeks after working.
7. Good nursery stock grown preferably in fumigated soil.
8. Italian Rye Grass is used as an annual cover crop in cultivated orchards; Kentucky Tall Fescue or Creeping Red Fescue is used as a permanent sod. These three grasses are poor hosts of the root-lesion nematode.

SINGLE TREE SITES FOR REPLACEMENT TREES

The procedure for preplant fumigation of single tree sites is the same as that described above, except that the fumigant is injected with a hand applicator (Fumigun) on 20 × 20 cm centers over a 2.5 × 2.5 m area. Rates per injection point are: Telone 0.8 mL; Vorlex Plus 0.2-0.5 mL (nematodes); Vorlex Plus 0.8-1.7 mL (nematodes, weeds, diseases). Fumiguns usually can be rented from custom applicators or pesticide dealers. Operators must wear protective equipment and clothing.

Vapam may be mixed with water and applied to individual replacement tree locations, as a drench in the fall, after the site has been prepared. For each replacement location, construct a circular basin in the soil — approximately 2 metres across.

Wearing protective equipment and clothing, add 0.3 litre of Vapam to 90 litres of water in a drum or tank. When solution is thoroughly agitated or mixed, apply it to each basin. This volume of solution is necessary for adequate penetration of the proposed root zone.

In climatic areas where fruit trees can be planted safely in the fall, Telone C-17-R can be used. However, it is necessary to allow a 3 to 6 month "aeration" period between soil treatment and tree planting. To avoid fumigant injury to the tree, prepare and treat the planting hole(s) in the spring and plant the tree(s) the following fall.

A suitable respirator and protective clothing, etc., must be worn by the applicator. Refer to CAUTION statement above and thoroughly read TOXICITY section on page 4.

Freshly prepared holes are treated in the spring by pouring 0.8 L of Telone C-17-R uniformly over the bottom of each hole.

VYDATE L-POSTPLANT TREATMENT

CAUTION — Vydate L is toxic to the applicator (see reference to Acute Toxicity and Blood Testing, page 4). Follow instructions closely regarding proper procedures for handling and application.

1. **Non-Bearing Apples**

   (a) **Postplant treatment of non-bearing apple trees** for reduction of root-lesion nematode numbers can be achieved with oxamyl (Vydate L = 240 g active oxamyl/L). Apply a liquid soil drench soon after planting. The liquid soil drench is mixed at 1.25 litres Vydate/1000 L water and applied at 3.5-10 L of solution per tree, in a circle around the base of the tree to cover the root zone. **Do not use if air temperature is below 7°C**, as Vydate is less effective at low temperatures. When leaves have expanded, apply a foliar application and repeat in 3-4 weeks. (Do not allow spray to drift on any trees in bloom). The foliar spray mix is 4.1-8.2 litres Vydate/1000 L water applied at not over 9.3 litres Vydate/ha in any one application. Soil sampling for nematodes in early September of the planting year is advisable to check on the need for further treatment.

   (b) **For established non-bearing apple trees,** apply the liquid soil drench early in April when buds are swelling. Apply a foliar spray before tight cluster and after petal fall. **DO NOT APPLY DURING THE PINK OR BLOOM PERIOD, AS VYDATE IS HIGHLY TOXIC TO BEES.**

   Root absorption of Vydate occurs during periods of rapid root growth (early spring). Foliar absorption occurs best in young, rapidly expanding foliage. See the manufacturer's label for further details, precautions and methods of application.

   No soil-borne disease control should be expected with Vydate L. Postplant treatments for nematode control are considered less effective than preplant soil fumigation. Postbloom foliar sprays will interfere with insect predators and are not recommended in orchards on IPM.

2. **Raspberries**

   For reduction in the number of root-lesion nematodes, Vydate L can be applied as a liquid soil drench over the root zone.

   Apply one application of Vydate L in the fall as a soil drench. Vydate is absorbed only by raspberry roots which are actively growing. Late application on dormant plants or when the air temperature is below 7°C may not give satisfactory results.

   Apply 9.35 L Vydate per hectare of treated soil area. If you are treating a 1.5 metre wide strip, use 1.4 L of Vydate in 360 L of water on 1000 metres of row.

   Do not apply more than once during a 12-month period.

CROP INSURANCE

The Canada-Ontario Crop Insurance Program is publicly funded by the Government of Canada and the Province of Ontario. The Federal and Provincial governments each contribute 25% of the premium cost and 50% of the administrative costs.

Both of these contributions enable an Ontario grower to purchase insurance coverage at a premium approximately equal to 44% of the total cost.

The grower's premium payment is considered an operating expense for income tax purposes. Crop insurance offers protection against loss from a broad range of production hazards, including excessive rain, excessive drought, winter damage, frost, hail, wind, certain pests and diseases, etc.

For further information contact your local crop insurance agent or:

The Crop Insurance Commission of Ontario
Ministry of Agriculture and Food
Legislative Buildings, Queen's Park
Toronto, Ontario M7A 1B7
Telephone (416) 326-3276

TABLE 18. CROPS FOR WHICH A CROP INSURANCE PLAN IS AVAILABLE IN ONTARIO INCLUDE:

Fruit Crops

Apples
Grapes
Peaches
Pears
Plums
Sour Cherries
Strawberries
Sweet Cherries

Vegetables

Asparagus
*Beans (green and wax, processing only)
Beets
Broccoli
Cabbage
Carrots
Cauliflower
Celery
Cucumbers
Lettuce
*Lima Beans (processing only)
Parsnips
*Peas (processing only)
Peppers
Potatoes
Pumpkins
Rutabagas
Seed Onions
Set Onions
Spanish Onions
Squash
Sweet corn (fresh)
*Sweet corn (processing)
Tomatoes
*Tomatoes (processing)

General Crops

Canola
Corn (grain and silage)
Seed Corn
Forage
New Forage Seeding
Honey
Peanuts
Popcorn
Spring grain
Soybeans
White beans
Coloured beans
Sunflowers
Winter Wheat
Red Spring Wheat

Tobacco

Flue-cured
Black

* *Insurance contracts are available through processing companies only.*
Insurance contracts for all other crops are available from crop insurance agents only.

OTHER INFORMATION FOR THE COMMERCIAL FRUIT PRODUCER

The following information, dealing with fruit production in Ontario generally is available at your local Agricultural office:

ONTARIO MINISTRY OF AGRICULTURE AND FOOD

Factsheets

072	Freeze Risk During Spring and Autumn in Ontario
079	The Behaviour of Frost in Ontario
200/628	Land Preparation: A Key to Successful Soil Fumigation
200/691	Effects of Air Pollution on Agricultural Crops
202/51	Pick Your Own Harvesting
202/65	Storage Incompatibility
202/736	Humidity in Refrigerated Storages for Fruits and Vegetables
206/532	Leaf Analysis for Fruit Crop Nutrition
210/07	Critical Temperatures for Fruit Blossoms
210/11	Predicting Blossom Time in the Niagara Peninsula
210/20	Winter Injury in Fruit Trees
210/22	Care of Fruit-Tree Nursery Stock from Nursery to Planting
210/24	Repair Grafting
210/24	Pruning Fruit Trees
210/24	Orchard Grafting Methods
210/63	Temporary Spring Storage of Young Fruit Trees
210/560	Irrigation Scheduling for Fruit Crops
210/624	Scale Insects of Tree Fruit
210/628	Root-Lesion Nematode in Ontario Orchards
210/681	Rodent and Deer Control in Orchards
211/20	Producing Quality Empire Apples
211/30	Disease Resistant Apple Cultivars
211/36	Apple Rootstocks
211/36	Managing Apple Trees on the M.26 Rootstock
211/50	Harvesting and Handling Apples
211/50	Starch-Iodine Test for Determining Maturity and Harvest Dates of Empire, Idared, and Spartan Apples
211/50	Evaluating Maturity of McIntosh and Red Delicious Apples
211/66	CA Storage Recommendations for Apples
211/624	Rosy Apple Aphid
211/624	Spotted Tentiform Leafminer
211/634	Apple Scab
211/634	Blister Spot of Apples
211/634	Fire Blight of Apple and Pear
211/634	Powdery Mildew of Apple
211/634	Flyspeck and Sooty Blotch of Apple
211/634	Apple Maggot
211/634	Codling Moth
211/634	Green Apple Aphid
211/634	White Apple Leafhopper
211/634	Woolly Apple Aphid
212/624	Insect and Mite Pests of Peach in Ontario
212/624	Comstock Mealy Bug on Peach
212/624	Oblique-Banded Leaf Roller
212/624	Oriental Fruit Moth
212/624	Plum Curculio
212/624	Peach Tree Borers
212/632	Pest Management Program for Grapes
212/632	Insect Pests of Grape in Ontario
212/632	Diseases of Grape in Ontario
212/634	Diseases and Nutrient Imbalances of Peach in Ontario
212/634	Brown Rot
212/634	Peach Canker
212/634	Peach Leaf-Curl
212/634	X-Disease of Peach
213/634	Bacterial Canker of Sweet Cherry
214/11	Growing Apricots
215/634	Pear Psylla in Ontario Pear Orchards
216/634	Black Knot of Plums
230/605	Insects and Diseases of Cane Fruits
231/24	Bunch-Thinning and Suckering Grapes
231/24	High-Cordon Trellising Systems for Grapes
231/600	Insect and Disease Identification Guide for Grapes
231/624	Grape Berry Moth
231/612	Grape Phylloxera
231/634	Botrytis Bunch Rot of Grapes
231/634	Downy Mildew of Grape
231/634	Phomopsis Cane and Leaf Spot of Grapes
231/634	Powdery Mildew of Grape
232/20	Dayneutral Strawberries
232/24	Growing Strawberries in Solid Beds
234/20	Growing Blackberries, Purple and Black Raspberries
236/12	Currants and Gooseberries
607	Management of Pesticides on the Farm
607	Pesticide Container Rinsing
607	Pesticide Contamination of Farm Water Supplies
607	Reducing Pesticide Drift and Crop Damage
607	Pesticide Handling Facility
607	Storing Pesticides on the Farm
616	Beekeeping – General Information
616	Honeybees for Pollination of Crops
616	Pollen Collection and Utilization
628	Soil and Root Sampling for Nematode Analysis
675	Sap Beetles

Numbered Publications

71	Honey Bees and Pesticides
72	Pollination Crops and Bees
75	Guide to Weed Control
105	Growing Red Raspberries in Ontario
213	Honey Bee Diseases and Pests
334	Rootstocks For Fruit Trees
373	Orchard Sprayers
392	Training and Pruning Fruit Trees
430	Fruit Cultivars – A Guide for Commercial Growers
505	Ontario Weeds – For Sale Only, $5.00
513	The Strawberry in Ontario
528	Planning and Planting the Orchard
	Integrated Pest Management for Apple Orchards in Ontario

AGRICULTURE CANADA PUBLICATIONS

Publications available from Communications Branch,
Agriculture Canada, Ottawa, K1A 0C7

1477	Lowbush Blueberry Production
1532	Commercial Storage of Fruits and Vegetables
1600	Beekeeping in Eastern Canada
1744	Strawberry Cultivars for Eastern Canada
1768	Post Harvest Handling of Pome Fruits, Soft Fruits and Grapes
1847	Controlled-atmosphere Disorders of Commercial Fruits and Vegetables
1863	Beneficial Insects and Common Pests on Strawberry and Vegetables

THE METRIC SYSTEM

Linear Measures (length)

10 millimetres (mm) = 1 centimetre (cm)
100 centimetres (cm) = 1 metre (m)
1000 metres = 1 kilometre (km)

Square Measures (area)

100 m × 100 m = 10,000 m^2 = 1 hectare (ha)
100 ha = 1 square kilometre (km^2)

Cubic Measures (volume)

Dry Measure

1000 cubic millimetres (mm^3) = 1 cubic centimetre (cm^3)
1,000,000 cm^3 = 1 cubic metre (m^3)

Liquid Measure

1000 millilitres (mL) = 1 litre (L)
100 L = 1 hectolitre (hL)

Weight – Volume Equivalents (for water)

(1.00 kg) 1000 grams = 1 litre (1.00 L)
(0.50 kg) 500 g = 500 mL (0.50 L)
(0.10 kg) 100 g = 100 mL (0.10 L)
(0.01 kg) 10 g = 10 mL (0.01 L)
(0.001 kg) 1 g = 1 mL (0.001 L)

Weight Measures

1000 milligrams (mg) = 1 gram (g)
1000 g = 1 kilogram (kg)
1000 kg = 1 tonne (t)
1 mg/kg = 1 part per million (ppm)

Dry – Liquid Equivalents

1 cm^3 = 1 mL
1 m^3 = 1000 L

APPLICATION RATE CONVERSIONS
(approximate)

Metric to Imperial

litres per hectare × 0.09	= gallons per acre
litres per hectare × 0.36	= quarts per acre
litres per hectare × 0.71	= pints per acre
millilitres per hectare × 0.015	= fluid ounces per acre
grams per hectare × 0.015	= ounces per acre
kilograms per hectare × 0.89	= pounds per acre
tonnes per hectare × 0.45	= tons per acre

Imperial to Metric

gallons per acre × 11.23	= litres per hectare (L/ha)
quarts per acre × 2.8	= litres per hectare (L/ha)
pints per acre × 1.4	= litres per hectare (L/ha)
fluid ounces per acre × 70	= millilitres per hectare (mL/ha)
tons per acre × 2.24	= tonnes per hectare (t/ha)
pounds per acre × 1.12	= kilograms per hectare (kg/ha)
ounces per acre × 70	= grams per hectare (g/ha)

Calculating Parts Per Million (ppm)
1 ppm = 1 g active ingredient per 1000 L water

Handy Metric Conversion Factor
Litres per hectare × 0.4 = litres per acre
Kilograms per hectare × 0.4 = kilograms per acre

CONVERSION TABLES – METRIC TO IMPERIAL

Length

1 millimetre (mm)	= 0.04 inch
1 centimetre (cm)	= 0.40 inch
1 metre (m)	= 39.40 inches
1 metre (m)	= 3.28 feet
1 metre (m)	= 1.09 yards
1 kilometre	= 0.62 mile

Volume (liquid)

1 millilitre (mL)	= 0.035 fluid ounce
1 litre (L)	= 1.76 pints
1 litre (L)	= 0.88 quart
1 litre (L)	= 0.22 gallon (Imperial)
1 litre (L)	= 0.26 gallon (U.S.)

Weight

1 gram (g)	= 0.035 ounce
1 kilogram (kg)	= 2.21 pounds
1 tonne (t)	= 1.10 short tons
1 tonne (t)	= 2205 pounds

Pressure

1 kilopascal (kPa)	= 0.15 pounds/square inch

Area

1 square centimetre (cm^2)	= 0.16 square inch
1 square metre (m^2)	= 10.77 square feet
1 square metre (m^2)	= 1.20 square yards
1 square kilometre (km^2)	= 0.39 square mile
1 hectare (ha)	= 107,636 square feet
1 hectare (ha)	= 2.5 acres

Volume (dry)

1 cubic centimetre (cm^3)	= 0.061 cubic inch
1 cubic metre (m^3)	= 1.31 cubic yards
1 cubic metre (m^3)	= 35.31 cubic feet
1000 cubic metres (m^3)	= 0.81 acre-foot
1 hectolitre (hL)	= 2.8 bushels

Speed

1 metre per second	= 3.28 feet per second
1 metre per second	= 2.24 miles per hour
1 kilometre per hour	= 0.62 mile per hour

Temperature

°F = (°C × 9/5) + 32

CONVERSION TABLES – IMPERIAL TO METRIC

(approximate)

Length

inch	= 2.54 cm
foot	= 0.30 m
yard	= 0.91 m
mile	= 1.61 km

Area

square foot	= 0.09 m^2
square yard	= 0.84 m^2
acre	= 0.40 ha

Weight

ounce	= 28.35 g
pound	= 453.6 g
ton	= 0.91 tonne

Volume (dry)

cubic yard	= 0.76 m^3
bushel	= 36.37 L

Volume (liquid)

fluid ounce (Imp.)	= 28.41 mL
pint (Imp.)	= 0.57 L
gallon (Imp.)	= 4.55 L
gallon (U.S.)	= 3.79 L

Pressure

pound per square inch	= 6.90 kPa

Temperature

°C = (°F–32) × 5/9

ABBREVIATIONS

ai	= active ingredient	mm	= millimetre
AP	= agricultural powder	cm	= centimetre
DG	= dispersible granular	m	= metre
DP	= dispersible powder	km	= kilometre
E	= emulsifiable	cm^2	= square centimetre
EC	= emulsifiable concentrate	m^2	= square metre
e.g.	= for example	ha	= hectare
F	= flowable	mL	= millilitre
Gr	= granules, granular	L	= litre
%	= percent (by weight)	g	= gram
SC	= sprayable concentrate	kg	= kilogram
SP	= soluble powder	t	= tonne
W	= wettable (powder)	kPa	= kilopascal
WDG	= water dispersible granular	m/s	= metres per second
WP	= wettable powder	km/h	= kilometres per hour

PERSONAL NOTES AND OBSERVATIONS

Table 19. PHYSICAL COMPATIBILITY OF SPRAY MATERIALS

Where a blank appears on the chart, the materials can be used together.

- □ — Compatible
- X — Do not use together
- • — Not recommended together in this calendar
- ? — Compatibility unknown
- OP — Organophosphorus compound

Do not mix pesticides with Agri-Mycin 17 or Lime Sulphur.

The chart applies only to the use of two material spray combinations for deciduous fruit. **When three or more materials are tank mixed together, further incompatibility may develop.**

Compatibilities of some materials may depend upon solvents and emulsifiers used by the manufacturer. Emulsifiable concentrate formulations are more likely to cause compatibility problems than wettable powders. **If wettable powders are mixed with emulsifiable concentrates, incompatibilities may result.**

Do not allow spray mixtures to sit overnight.

1. Should not be used with or within 14 days of oil application.
2. May cause injury on grapes.
3. Residual action reduced.
4. May cause injury under some weather conditions.
5. Consult manufacturer regarding suitable oil for combination to be used on apple. Do not use it later than half-inch green stage (see page 00).
6. Use EC formulations.
7. Use WP formulations.
8. Combination may cause necrotic spotting on Delicious.
9. Apply immediately with agitation.
10. When mixing captan with EC formulations of pyrethroids, add captan first. Apply immediately with constant agitation.
11. Chemically similar materials.

Table 20. PESTICIDES USED TO PROTECT FRUIT CROPS (in publication 360)

a	– acaracide, miticide	i	– insecticide
b	– bactericide	n	– nematicide
f	– fungicide	r	– rodenticide
h	– herbicide	x	– repellent

Brand or Trade Name	( )		Common or Chemical Name	Brand or Trade Name	( )		Common or Chemical Name
Agri-Mycin 17	3	b	streptomycin sulphate	Kumulus DF	6	f	sulphur
Ambush, Pounce	3	i	permethrin	Lannate L	2	i	methomyl
APM, Guthion	5	i	azinphos methyl	Malathion	3	i	malathion
Apollo	2	a	clofentezine	Manzate 200, Manzate DF	3	f	mancozeb
Basudin, Diazinon	2	i	diazinon	Metasystox-R	2	i	oxydemeton-methyl
Belmark	2	i	fenvalerate	Morestan	3	af	chinomethionat
Benlate	3	f	benomyl	Omite	3	a	propargite
Botran	3	f	dichloran	Orthocide, Captan	2	f	captan
Captan, Orthocide	2	f	captan	Parathion	5	i	parathion
Carzol	5	a	formetanate hydrochloride	Folpan	2,3	f	folpet
Cygon	2	i	dimethoate	Phygon-XL	3	f	dichlone
Cymbush 12.5% WP	3	i	cypermethrin	Pirimor	2	i	primicarb
Cymbush 250 EC	2	i	cypermethrin	Polyram	3	f	metiram
Cyprex, Equal	3	f	dodine	Pounce, Ambush	3	i	permethrin
Decis	2	i	deltamethrin	Ramik Brown	6	r	diphacinone
Diazinon, Basudin	2	i	diazinon	Ridomil 240 EC	2	f	metalaxyl
Dikar	3	af	no common name	Ripcord	2	i	cypermethrin
Dithane DG	3	f	mancozeb	Rovral	3	f	iprodione
Dithane M-45	3	f	mancozeb	Rozol	3,6	r	chlorophacinone
Dithane Z-78	3	f	zineb	Sevin	3	i	carbaryl
Dyrene	3	f	anilazine	Superior Oil	6	ai	mineral oil
Elgetol	2	f	DNOC	Supracide	2	i	methidathion
Equal, Cyprex	3	f	dodine	Telone C-17	2	bfhin	1,3 dichloropropene
Ethion	2	i	ethion	Telone II-B	2	n	1,3 dichloropropene
Ferbam	3	f	ferbam	Thiodan, Thionex	2	i	endosulfan
Funginex	6	f	triforine	Vapam	3	bfhin	metam sodium
Furadan	5	i	carbofuran	Vorlex Plus	2	bfhin	1,3 dichloropropene + methyl isothiocyanate
Guthion, APM	5	i	azinphos methyl				
Hinder	6	x	ammonium salts of higher fatty acids	Vorlex Plus CP	2	bfhin	1,3 dichloropropene + methyl isothiocyanate + chlorpicrin
Imidan	3	i	phosmet				
Karathane	2	af	dinocap	Vydate	5	in	oxamyl
Kelthane	2	a	dicofol	Zineb	3	f	zineb
KSC5	6	r	chlorophacinone	Zolone Flo	2	i	phosalone

The numbers in this column ( ) identify the Schedules in which the BRAND NAME products listed in this table are classified under the Pesticides Act.

Explanation of Schedules

Schedule 1 Restricted. Use permit only.
Schedule 2 Restricted to agriculturalists, licensed exterminators and registered custom sprayers.
Schedule 3 May be available for "Domestic" purposes if so registered.
Schedule 4 "Domestic" products only.
Schedule 5 Limited to application by an agriculturalist.
Schedule 6 Similar to Schedule 4 but may be registered for agricultural/commercial use.

For further information on the regulatory aspects of the classification please contact the Ministry of the Environment office nearest you. See page 3.

Table 21. PESTICIDES USED TO PROTECT FRUIT CROPS (in publication 360)

a – acaricide, miticide
b – bactericide
f – fungicide
h – herbicide
i – insecticide
n – nematicide
r – rodenticide

Common or Chemical Name		Brand or Trade Name	Common or Chemical Name		Brand or Trade Name
anilazine	f	Dyrene	endosulfan	i	Thiodan, Thionex
azinphos methyl	i	APM, Guthion	ethion	i	Ethion
benomyl	f	Benlate	fenvalerate	i	Belmark
blue stone	bf	copper sulfate	ferbam	f	Ferbam
borax	f	sodium tetraborate deca-hydrate	fixed copper	b	various formulations
bordeaux	f	prepared in spray tank: copper sulfate, hydrated lime and water	folpet	f	Folpan
			formetanate hydrochloride	a	Carzol
			iprodione	f	Rovral
captan	f	Captan, Orthocide	malathion	i	Malathion
carbaryl	i	Sevin	mancozeb	f	Dithane DG, Dithane M-45 Manzate 200, Manzate DF
carbofuran	i	Furadan			
chinomethionat	af	Morestan	metalaxyl	f	Ridomil
chlorophacinone	r	Rozol, KSC5	metaldehyde	i	metaldehyde
clofentezine	a	Apollo	metam sodium	bfhin	Vapam
copper sulphate	bf	blue stone	methidathion	i	Supracide
cypermethrin	i	Cymbush, Ripcord	metiram	f	Polyram
deltamethrin	i	Decis	methomyl	i	Lannate L
diazinon	i	Basudin, Diazinon	mineral oil	ai	Superior Oil
1,3 dichloropropene	n	Telone II-B, Telone C-17	oxamyl	i	Vydate
1,3 dichloropropene + methyl isothiocyanate + chlorpicrin	bfhin	Vorlex Plus CP	oxydemeton-methyl	i	Metasystox-R
			parathion	i	Parathion
			permethrin	i	Ambush, Pounce
1,3 dichloropropene + methyl isothiocyanate	bfhin	Vorlex Plus	phosalone	i	Zolone Flo
			phosmet	i	Imidan
dichlone	f	Phygon-XL	pirimicarb	i	Pirimor
dichloran	f	Botran	propargite	a	Omite
dicofol	a	Kelthane	streptomycin sulphate	b	Agri-Mycin 17
dimethoate	i	Cygon	sulphur	f	Kumulus DF, various others
dinocap	af	Karathane	thiram	f	Thiram
diphacinone	r	Ramik Brown	triforine	f	Funginex
DNOC	f	Elgetol	zineb	f	Zineb, Dithane Z-78
dodine	f	Cyprex, Equal	zinc phosphide	r	various formulations

Table 22. NUMBER OF DAYS FROM LAST SPRAY TO HARVEST

Read the Label and Follow All Safety Precautions.

Canada's Department of National Health and Welfare has established amounts of insecticides and fungicides that may remain on fruits at time of harvest. To avoid exceeding these tolerances, use recommended amounts and do not spray nearer to harvest than number of days shown below, or not later than stage indicated. This is subject to change by Information Letter as additional information is available. For tank mixes of two or more materials, use the longest time period given for any of the materials.

Do not apply a pesticide more often than recommended on the label.

A	within 14 days of petal fall
B	not used alone
C	Do not use later than recommended in this calendar
D	dormant
DD	delayed dormant
PB	pre-bloom
PH	post harvest
SS	shuck split
V	vegetative year only
X	no tolerance for pesticide on that fruit
—	pesticide not recommended in this calendar on this crop

	Apple	Pear	Cherry	Peach and Nectarine	Plum	Grape	Black-berry Rasp-berry	Straw-berry	Apricot	Currant and Goose-berry	Blue-berry
Agri-Mycin 17	50	30	—	—	—	—	—	—	—	—	—
Ambush	7	7	—	7	—	7	—	—	—	—	—
APM	7	7	15	21	—	28	—	—	—	—	V
Apollo	A	—	—	—	—	—	—	—	—	—	14
Belmark	60	60	X—	X—	X—	X—	X—	X—	X—	X—	X—
Benlate	1	A	1	1	1	1	1	1	1	—	—
Botran	—	—	—	1	—	—	—	—	—	—	—
captan	7	7	2*	2	2	7	2	2	2	—	2
captan-benomyl	7	—	—	2	2	—	—	—	2	—	—
Carzol	1	1	—	—	—	—	—	—	—	—	—
Cygon	14	14	15	—	X—	X—	X—	XC	—	—	—
Cymbush	7	7	—	—	—	7	—	7	—	—	—
Cyprex	7—	7	7	—	X—	X—	X—	7	—	—	—
Decis	1	7	—	7	—	—	—	14	—	—	14
diazinon	14	14—	10	20—	10	16	X—	5—	—	—	—
Dikar	45	45	—	—	—	30	—	—	—	—	—
Dithane DG	45	—	—	—	—	—	—	—	—	—	—
Dithane M-45	—	45	X—	X—	X—	30	X—	X—	X—	X—	X—
DNOC (Elgetol)	XD—	XD	XD—	XD—	XD—	XDD	X—	—	XD	—	—
Dyrene	—	—	—	—	—	—	—	5	—	—	14
Easout	B2	—	1	1	1	—	1	1	—	—	—
Equal	7—	7	7	—	X—	X—	X—	7	—	—	—
ethion	30	30	—	30	30	30—	—	8	D	—	—
ferbam	7	7—	4	21	7—	7	XC	—	21	14	40
Folpan	1	X—	1	X—	X—	1	—	1	—	7	1
Funginex	—	—	C	C	C	—	—	—	—	—	60
Furadan	—	—	—	—	—	—	—	XC	—	—	—
Guthion	7	7	15	15	15	28	7	5	21	—	14
Hinder	14	14	14	14	14	14	14	14	14	14	14
Imidan	1	1	7	1	1	7	X—	X—	—	—	—
Karathane	21	21	X—	X—	X—	30	X—	X—	—	—	—
Kelthane	7	7	7	14	7	7	7	7	14	—	—
Lannate L	8	—	—	—	—	—	X—	—	—	—	—
malathion	3	—	3	7—	3	3—	1	3	7	3	1
Manzate 200	45	45	X—	X—	X—	30	X—	X—	—	—	—
Morestan	PB	PB	PB—	PB—	PB—	X—	X—	X—	PB—	—	—
Omite	7	PH	PH	14	28	28	—	7	14	—	—
parathion	14	14	14	14	14	14—	—	14	14	—	—
Phygon-XL	1	X—	1	SS	C	X—	X—	—	—	—	—
Pirimor	35	—	—	—	—	—	—	—	—	—	—
Polyram DF	45	X—	—	X—	X—	45	X—	X—	—	—	—
Pounce	7	7	—	—	—	21	—	—	—	—	—
Ridomil	XC	—	—	—	—	—	XC	XC	—	—	—
Ripcord	7	7	—	—	—	—	—	7	—	—	—
Rovral	—	—	1	1	—	7	—	1	—	—	—
Sevin	7	7	1	1	1—	3	—	1—	3	—	1
sulphur, Kumulus DF	1	1	1	1	1	1**	—	—	—	1	—
Supracide	XC	—	—	—	—	—	—	—	—	—	—
Thiodan, Thionex	15	15	15	15	15	30	X—	7	—	—	—
zineb	45	45	—	—	—	—	—	—	—	—	—
Zolone Flo	1	7	7	7	14	14	—	—	—	—	—

** 5 days on Sour Cherry* *** 21 days on Wine Grapes*

PERSONAL NOTES AND OBSERVATIONS

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ACKNOWLEDGEMENTS

The recommendations contained in this publication have been prepared in consultation with:

— Ontario Crop Protection Committee
— Ontario Horticultural Research Committee
— Ontario Soil Management Research Committee

and personnel of:

— Plant Industry Branch, Ontario Ministry of Agriculture and Food
— Agriculture Canada
— Ontario Agricultural College, University of Guelph
— Horticultural Research Institute of Ontario
— Ontario Ministry of the Environment
— Ontario Ministry of Labour
— Health and Welfare Canada

SPRAYING RECORD

CROP OR FIELD NO.	DATE	MATERIAL USED	RATE OR AMOUNT	WEATHER AND SOIL CONDITIONS

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EMERGENCY AND FIRST-AID PROCEDURES

FOR PESTICIDE POISONING

Become familiar with the chemicals you are using. Keep a list of common names in case of accidents or emergencies. This information can be found on the product labels and cross-referenced in this publication.

If a pesticide has come in contact with the skin or has been spilled on clothing, remove the clothing and wash the skin thoroughly with soap and warm water. Repeat the wash.

If a pesticide has come in contact with the eyes, rinse them with plenty of clean water for 15 minutes.

If a person suspects poisoning from exposure to a pesticide by swallowing, inhalation, or contact with skin or eyes, read the label on the pesticide container and carry out the first-aid treatment suggested.

IMMEDIATELY AFTER THE FIRST-AID TREATMENT HAS BEEN GIVEN, WRAP THE PATIENT IN A COAT OR BLANKET AND RUSH HIM TO THE NEAREST HOSPITAL. TAKE THE LIST OF CHEMICAL COMMON NAMES WITH YOU AND IDENTIFY THE ONES BEING USED.

IF A PERSON IS FOUND UNCONSCIOUS OR LAPSES INTO UNCONSCIOUSNESS, CALL AN AMBULANCE IMMEDIATELY.

EMERGENCY ADVICE ON PESTICIDE POISONING IS AVAILABLE BY CONTACTING THE POISON INFORMATION CENTRES: THE NAMES AND TELEPHONE NUMBERS ARE LISTED UNDER EMERGENCY CALLS AT THE FRONT OF EACH BELL TELEPHONE DIRECTORY.

Fill in the following:

MY LOCAL POISON INFORMATION CENTRE TELEPHONE NUMBER IS:

_____ - _____